ILLUSTRATED
ELECTRICAL REVIEW
A Journal of Scientific and Electrical Progress.

VOL. 22. No. 18. WEEKLY. | NEW YORK, SATURDAY, JUNE 24, 1893. | $3 per Annum. Single Copies, 10 Cents.

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Entered at Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

Two sprinkling cars are shortly to be placed in operation on a Baltimore electric line. The car carries a tank of 2,300 gallons capacity and it will wet down at one filling between five and six miles of road along the track. This invention promises to succeed the slower and more expensive systems now in vogue by horse-power. It will be available wherever there are car lines of any sort, and in time the horse vehicles will be employed only on streets not thus equipped.

It would seem that the promise given by the preparations at Niagara Falls for the generation of electric power is likely to bring the advocates of rival power systems into the field. It is not improbable that within a few years experiments on a large scale will be possible on the relative efficiency of power transmission by compressed air and by electricity. Professor Unwin has treated the subject of compressed air as a motive power in a recent lecture. He considers transmission by it as practical, to a distance of 20 miles at least. He maintains that 10,000 horse-power can be transmitted to a distance of 30 miles in a 30 inch main at 132.3 pounds per square inch with a loss of pressure of only 12 per cent. The efficiency of such a plant is said to be 40 or 50 per cent. if the air is used cold, and 59 to 73 per cent. if the air is reheated. In order to put the system to a thorough test on a large scale it is now proposed to produce power at Niagara Falls by compressed air in competition with electricity.

Lavaoid is a cement for iron and stone that is now being introduced by a Vienna firm. The Austrian authorities speak of the compound in the highest terms. It consists of sulphur, iron, silicic acid and alumina, and is used in a molten condition. Its applications in iron and stone work are stated to be numerous. It serves also as an electric insulator. It melts at 125 degrees C., and cools quickly.

At a recent meeting of the British Royal Society one of the members exhibited some curious photographs, produced by placing coins, medals and such like objects on a sensitive plate. An electrical discharge was sent through the object, and a developer then applied to the film, whereby images of the designs upon the objects were obtained. The best results were produced in oxygen. No effect could be obtained in a good vacuum. Changes of temperature made little difference in the results, while increase of atmosphere pressure was found to improve definition.

The insulating department of the Stanley Electric Manufacturing Company, in Pittsfield, Mass., was destroyed by fire last week. The loss to the company in product in process of completion and in damaged machinery, etc., is probably $6,000. Insurance, $3,000.

Thunder storms are more frequent in Java than in any other part of the world, there being an average of 97 days in each year upon which they occur.

An apparatus has been constructed for telephoning simultaneously over telegraph wires. The system has been in operation for some time on the telephone line from Budapest to Szegedin, a distance of 124 miles. The results were satisfactory. The apparatus can easily be inserted in a telegraph circuit and used at once. It is said that simultaneous telegraphy along the wire does not in the least interfere with telephoning, and that the effects of induction and all disturbing noises are completely removed.

It is against the rules at the World's Fair to have more than a quart of benzine in a building at any time. During the construction of the telephone exchange, at Jackson Park, one of the foremen, for some reason, wanted a gallon of benzine. He went outside for it himself, carried it to the building and set it down out of sight around the corner. Then he walked up to the pompous Columbian guard at the door of the building.

"Want to talk to New York?"

"Don't care if I do," answered the guard.

And then the wily electrician sat the guard down in front of an instrument through which he inquired in detail as to the latest news in New York. While a boy at the switchboard in the other room concocted New York news by the yard, the foreman sneaked in the benzine and incurred the guard's everlasting friendship for allowing him to talk to New York.

Humming merrily upon a low table in the doctor's office, affording relief from a recent "advance sheet" of the prophesied "sizzard," was an electric fan of the high speed variety.

It was about two seconds after the inquisitive five-year-old *enfant terrible* had introduced himself and had shaken hands with it when the entire family were attracted by his dismal howling. Questions were fired at him right and left, but he kept up his screeching. Suddenly he stopped, and plucking up courage to look at his hand which he had held behind him, and seeing that it was not as badly damaged as he expected, said in a measured tone: "Well, I guess I can play the piano, anyway."

BOOTH OF THE COMMERCIAL CABLE COMPANY AT THE WORLD'S FAIR.

The Commercial Cable Company's Exhibit at the World's Fair.

In the west gallery of the Electricity Building at the World's Fair is situated the booth of the Commercial Cable Company. The company shows a remarkably fine exhibit, comprising instruments and curiosities of much scientific interest. In a large glass case is a very handsome model of their repairing steamer "Mackay-Bennett," named after the promotors, Messrs. John W. Mackay, the California millionaire, and Mr. James Gordon Bennett, the editor of the New York *Herald*, who in 1884 formed this company. Business as now done by the "Mackey-Bennett" system owes its state to the numerous improvements which have been made in the transmitting and receiving instruments. No longer are flashes of light used to obtain messages, but Sir William Thomson's now well known siphon recorder, improved upon by Mr. Charles Cuttriss, the company's electrician, renders the receiving much simpler; in fact, it has put cabling on a more secure and commercial basis.

In the exhibit may also be seen two forms of automatic senders or transmitters, one of them a modified Wheatstone automatic transmitter improved by Mr. T. J. Wilmot, the Commercial Cable Company's superintendent at Waterville, Ireland. The second form of automatic transmitter is an ingenious device. It is the invention of Mr. Cuttriss. In this instrument indenters are substituted for the perforators of the paper ribbon, thus saving time and trouble, for they require but little attention. In this, also, another advantage is gained; an intermittent motion is imparted to the ribbon, by which it is possible to vary the duration of current and earth contacts in any proportion of one to the other. The clock-work and weight of the older forms are abolished, and a continuous motion is obtained from a self-governing electro-motor, also the design of Mr. Charles Cuttriss, which will run efficiently with six gravity cells of battery and not vary its speed if placed in an electric light circuit.

A number of curiosities in the way of broken and crushed cables may also be seen, and it is with a kind of awe or reverence that the observer looks at historic bits of mangled wire which once lay upon the bed of the Atlantic Ocean. If it were possible for them to talk, what weird and peculiar stories could they tell of life under the ocean wave! Several other remarkably well designed and constructed pieces of apparatus used by the company, among which may be mentioned the Muirhead standard cell, standard condenser and inductive resistance, or artificial line, and the Cuttriss motor completes this most interesting exhibit.

Tree Insulator Inventor, Attention!

We have had a request for the address of the inventor of the tree insulator mentioned on the first page of the ELECTRICAL REVIEW for June 17, 1893. Will he or his friends please respond?

On Light and Other High Frequency Phenomena.

A LECTURE DELIVERED BEFORE THE FRANKLIN INSTITUTE, AT PHILADELPHIA, FEBRUARY 24, 1893, AND BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., MARCH 1, 1893.

BY NIKOLA TESLA.

(*Continued from page 217.*)

When a conducting body is immersed in air, or similar insulating medium, consisting of or containing small freely movable particles capable of being electrified, and when the electrification of the body is made to undergo a very rapid change—which is equivalent to saying that the electrostatic force acting around the body is varying in intensity—the small particles are attracted and repelled, and their violent impacts against the body may cause a mechanical motion of the latter. Phenomena of this kind are noteworthy in as much as they have not been observed before with apparatus such as has been commonly in use. If a very light conducting sphere be suspended on an exceedingly fine wire, and charged to a steady potential, however high, the sphere will remain at rest. Even if the potential would be rapidly varying, provided that the small particles of matter, molecules or atoms, are evenly distributed, no motion of the sphere should result. But if the side of the conducting sphere is covered with a thick insulating layer, the impacts of the particles will cause the sphere to move about, generally in irregular curves, Fig. 8*a*. In like manner, as I have shown on a previous occasion, a fan of metal sheet, Fig. 8*b*, covered partially with insulating material as indicated, and placed upon the terminal of the coil so as to turn freely in it, is spun around.

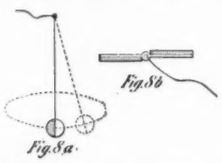


Fig. 8*b*

Fig. 8*a*

TESLA LECTURE.—MECHANICAL MOTIONS PRODUCED BY VARYING ELECTROSTATIC FORCE IN A GASEOUS MEDIUM.

All the phenomena you have witnessed, and others which will be shown later, are due to the presence of a medium like air, and would not occur in a continuous medium. The action of the air may be illustrated still better by the following experiment: I take a glass tube *t*, Fig. 9, of about an inch in diameter, which has a platinum wire, w, sealed in the lower end, and to which is attached a thin lamp filament *f*. I connect the wire with the terminal of the coil and set the coil to work. The platinum wire is now electrified positively and negatively in rapid succession and the wire and air inside of the tube is rapidly heated by the impacts of the particles, which may be so violent as to render the filment incandescent. But if I pour oil in the tube, just as soon as the wire is covered with the oil, all action apparently ceases and there is no marked evidence of heating. The reason of this is that the oil is a practically continuous medium. The displacements in such a continuous medium are, with these frequencies, to all appearance incomparably smaller than in air, hence the work performed in such a medium is insignificant. But oil would behave very differently with frequencies many times as great, for even though the displacements be small, if the frequency were much greater considerable work might be performed in the oil.

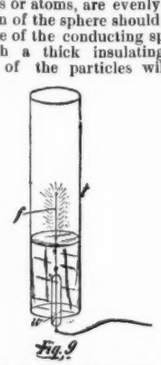


Fig. 9

TESLA LECTURE.—SHOWING THE EFFECT OF THE AIR.

The electrostatic attractions and repulsions between bodies of measurable dimensions are, of all the manifestations of this force, the first so-called *electrical* phenomena noted. But, though they have been known to us for many centuries, the precise nature of the mechanism concerned in these actions is still unknown to us, and has not been even quite satisfactorily explained. What kind of mechanism must that be? We cannot help wondering when we observe two magnets attracting and repelling each other with a force of hundreds of pounds with apparently nothing between them. We have in our commercial dynamos magnets capable of sustaining in mid-air tons of weight. But what are even these forces acting between magnets when compared with the tremendous attractions and repulsions produced by electrostatic force, to which there is apparently no limit as to intensity. In lightning discharges bodies are often charged to so high a potential that they are thrown away with inconceivable force and torn asunder or shattered into fragments. Still, even such effects cannot compare with the attractions and repulsions which exist between charged molecules or atoms, and which are sufficient to project them with speeds of many kilometres a second, so that under their violent impact bodies are rendered highly incandescent and are volatilized. It is of special interest for the thinker, who inquires into the nature of these forces, to note that, whereas the actions between individual molecules or atoms occur seemingly under any condition, the attractions and repulsions of bodies of measurable dimensions imply a medium possessing insulating properties. So, if air, either by being rarefied or heated, is rendered more or less conducting, these actions between two electrified bodies practically cease, while the actions between the individual atoms continue to manifest themselves.

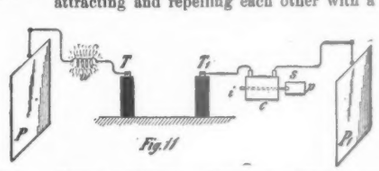


Fig. 11

TESLA LECTURE.—SHOWING EFFECTS OF CURRENTS FLOWING THROUGH OPEN CIRCUITS.

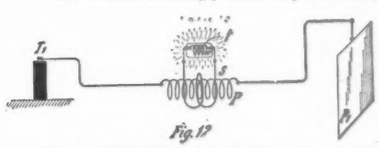


Fig. 17

TESLA LECTURE.—CONVERSION ON OPEN CIRCUIT WITH COIL AND INSULATED PLATE.

An experiment may serve as an illustration and as a means of bringing out other features of interest. Some time ago I showed that a lamp filament or wire mounted in a bulb and connected to one of the terminals of a high tension secondary coil is set spinning, the top of the filament generally describing a circle. This vibration was very energetic when the air in the bulb was at ordinary pressure and became less energetic when the air in the bulb was strongly compressed. It ceased altogether when the air in the bulb was exhausted so as to become comparatively good conducting. I found at that time that no vibration took place when the bulb was very highly exhausted. But I conjectured that the vibration which I ascribed to the electrostatic action between the walls of the bulb and the filament should take place also in a highly exhausted bulb. To test this under conditions which were more favorable, a bulb like the one in Fig. 10 was constructed. It comprised a globe *b*, in the neck of which was sealed a platinum wire *w* carrying a thin lamp filament *f*. In the lower part of the globe a tube *t* was sealed so as to surround the filament. The exhaustion was carried as far as it was practicable with the apparatus employed.

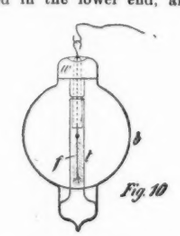


Fig. 10

TESLA LECTURE.—SHOWING THE INFLUENCE OF THE CONDUCTIVITY OF THE MEDIUM UPON ELECTROSTATIC ACTIONS THROUGH MEASURABLE DISTANCE.

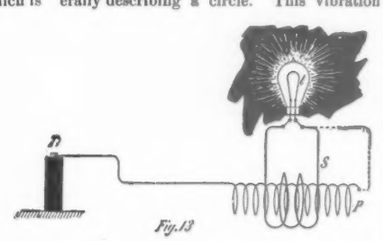


Fig. 13

TESLA LECTURE.—CONVERSION ON OPEN CIRCUIT WITH COIL ALONE.

This bulb verified my expectation, for the filament was set spinning when the current was turned on, and became incandescent. It also showed another interesting feature, bearing upon the preceding remarks, namely, when the filament had been kept incandescent some time the narrow tube and the space inside was brought to an elevated temperature, and as the gas in the tube then became conducting, the electrostatic attraction between the glass and the filament became very weak or ceased and the filament came to rest. When it came to rest it would glow far more intensely. This was probably due to its assuming the position in the center of the tube where the molecular bombardment was most intense, and also partly to the fact that the individual impacts were more violent and that no part of the supplied energy was converted into mechanical movement. Since, in accordance with accepted views, in this experiment the incandescence must be attributed to the impacts of the particles, molecules or atoms in the heated space, these particles must, therefore, in order to explain such action, be assumed to behave as independent carriers of electric charges immersed in an insulating medium; yet there is no attractive force between the glass tube and the filament because the space in the tube is, as a whole, conducting.

It is of some interest to observe in this connection that whereas the attraction between two electrified bodies may cease, owing to the impairing of the insulating power of the medium in which they are immersed, the repulsion between the bodies may still be observed. This may be explained in a plausible way. When the bodies are placed at some distance in a poorly conducting medium, such as slightly warmed or rarefied air, and are suddenly electrified, opposite electric charges being imparted to them, these charges equalize more or less by leakage through the air. But if the bodies are similarly electrified, there is less opportunity afforded for such dissipation, hence the repulsion observed in such case is greater than the attraction. Repulsive actions in a gaseous medium are, however, as Professor Crookes has shown, enhanced by molecular bombardment.

ON CURRENT OR DYNAMIC ELECTRICITY PHENOMENA.

So far, I have considered principally effects produced by a varying electrostatic force in an insulating medium, such as air. When such a force is acting upon a conducting body of measurable dimensions, it causes within the same, or on its surface, displacements of the electricity and gives rise to electric currents, and these produce another kind of phenomena, some of which I shall presently endeavor to illustrate. In presenting this second class of electrical effects, I will avail myself principally of such as are produceable without any return circuit, hoping to interest you the more by presenting these phenomena in a more or less novel aspect.

It has been for a long time customary, owing to the limited experience with vibratory currents, to consider an electric current as something circulating in a closed conducting path. It was astonishing at first to realize that a current may flow through the conducting path even if the latter be interrupted, and it was still more surprising to learn that sometimes it may be even easier to make a current flow under such conditions than through a closed path. But that old idea is gradually disappearing, even among practical men, and will soon be entirely forgotten.

If I connect an insulated metal plate P, Fig. 11, to one of the terminals T of the induction coil by means of a wire, though this plate be very well insulated, a current passes through the wire when the coil is set to work. First I wish to give you evidence that there is a current passing through the connecting wire. An obvious way of demonstrating this is to insert between the terminal of the coil and the insulated plate a very thin platinum or German silver wire *w*, and bring the latter to incandescence or fusion by the current. This requires a rather large plate or else current impulses of very high potential and frequency. Another way is to take a coil C, Fig. 11, containing many turns of thin insulated wire and to insert the same in the path of the current to the plate. When I connect one of the ends of the coil to the wire leading to another insulated plate P, and its other end to the terminal T_1 of the induction coil, and set the latter to work, a current passes through the inserted coil C and the existence of the current may be made manifest in various ways. For instance, I insert an iron core *i* within the coil. The current being one of very high frequency, if it be of some strength, will soon bring the iron core to a noticeably higher temperature, as the hysteresis and current losses are great with such high frequencies. One might take a core of some size, laminated or not, it would matter little; but ordinary iron wire $\frac{1}{16}$th or $\frac{1}{8}$th of an inch thick is suitable for the purpose. While the induction coil is working a current traverses the inserted coil and only a few moments are sufficient to bring the iron wire *i* to an elevated temperature sufficient to soften the sealing-wax *s*, and cause a paper washer *p* fastened by it to the iron wire to fall off. But with the apparatus such as I have here other much more interesting demonstrations of this kind can be made. I have a secondary S, Fig. 12, of coarse wire, wound upon a coil similar to the first. In the preceding experiment the current through the coil C, Fig. 11, was very small, but, there being many turns, a strong heating effect was, nevertheless, produced in the iron wire. Had I passed that current through a conductor in order to show the heating of the latter, the current might have been too small to produce the effect desired. But with this coil provided with a secondary winding, I can now transform the feeble current of high tension which passes through the primary P into a strong secondary current of low tension, and this current will quite certainly do what I expect. In a small glass tube (*t*, Fig. 12), I have enclosed a coiled platinum wire *w*, this merely in order to protect the wire. On each end of the glass tube is sealed a terminal of stout wire to which one of the ends of the platinum wire *w* is connected. I join the terminals of the secondary coil to these terminals and insert the primary *p* between the insulated plate P_1 and the terminal T_1 of the induction coil as before. The latter being set to work, instantly the platinum wire *w* is rendered incandescent and can be fused even if it be very thick.

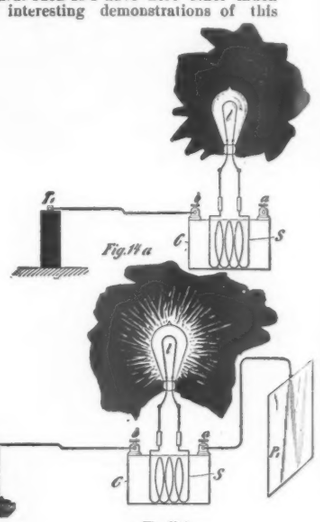


Fig. 14*a*

Fig. 14*b*

TESLA LECTURE.—EFFECT OF ATTACHED PLATE WITH LOW FREQUENCIES.

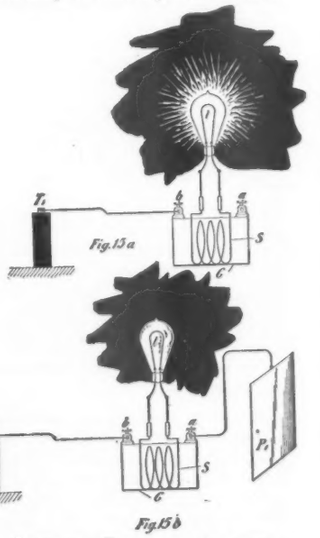


Fig. 15*a*

Fig. 15*b*

TESLA LECTURE.—EFFECT OF ATTACHED PLATE WITH HIGH FREQUENCIES.

Instead of the platinum wire, I now take an ordinary 50-volt 16 candle-power lamp.

When I set the induction coil in operation the lamp filament is brought to high incandescence. It is, however, not necessary to use the insulated plate, for the lamp (*l* Fig. 13) is rendered incandescent even if the plate P_1 be disconnected. The secondary may also be connected to the primary as indicated by the dotted line in Fig. 13, to do away more or less with the electrostatic induction or to modify the action otherwise.

I may here call attention to a number of interesting observations with the lamp. First, I disconnect one of the terminals of the lamp from the secondary S. When the induction coil plays, a glow is noticed which fills the whole bulb. This glow is due to electrostatic induction. It increases when the bulb is grasped with the hand, and the capacity of the experimenter's body thus added to the secondary circuit. The secondary, in effect, is equivalent to a metallic coating, which would be placed near the primary. If the secondary, or its equivalent, the coating, were placed symmetrically to the primary, the electrostatic induction would be *nil* under ordinary conditions, that is, when a primary return circuit is used, as both halves would neutralize each other. The secondary is in fact placed symmetrically to the primary, but the action of both halves of the latter, when only one of its ends is connected to the induction coil, is not exactly equal; hence, electrostatic induction takes place, and hence the glow in the bulb. I can nearly equalize the action of both halves of the primary by connecting the other free end of the same to the insulated plate, as in the preceding experiment. When the plate is connected, the glow disappears. With a smaller plate it would not entirely disappear, and then it would contribute to the brightness of the filament when the secondary is closed by warming the air in the bulb.

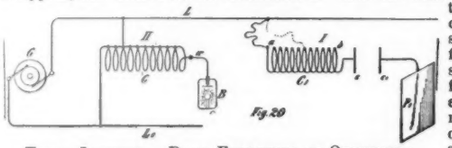


Fig. 20

TESLA LECTURE.—PLAN FOLLOWED IN OBSERVING THE EFFECTS OF RESONANCE.

To demonstrate another interesting feature, I have adjusted the coils used in a certain way. I first connect both the terminals of the lamp to the secondary, one end of the primary being connected to the terminal T_1 of the induction coil and the other to the insulated plate P_1 as before. When the current is turned on, the lamp glows brightly, as shown in Fig. 14*b*, in which C is a fine wire coil and S a coarse wire secondary wound upon it. If the insulated plate P_1 is disconnected, leaving one of the ends *a* of the primary insulated, the filament becomes dark or generally it diminishes in brightness (Fig. 14*a*). Connecting again the plate P_1 and raising the frequency of the current I make the filament quite dark or barely red, Fig. 15*b*. Once more I will disconnect the plate. One will of course infer that when the plate is disconnected, the current through the primary will be weakened that, therefore the electromotive force will fall in the secondary S, and that the brightness of the lamp will diminish. This might be the case and the result can be secured by an easy adjustment of the coils; also by varying the frequency and potential of the currents. But it is perhaps of greater interest to note that the lamp increases in brightness when the plate is disconnected (Fig. 15*a*). In this case all the energy the primary receives is now sunk into it, like the charge of a battery in an ocean cable, but most of that energy is recovered through the secondary and used to light the lamp. The current traversing the primary is strongest at the end *b* which is connected to the terminal T_1 of the induction coil, and diminishes in strength towards the remote end *a*. But the dynamic inductive effect exerted upon the secondary S is now greater than before, when the suspended plate was connected to the primary. These results might have been produced by a number of causes. For instance, the plate P_1 being connected, the reaction from the coil C may be such as to diminish the potential at the terminal T_1 of the induction coil and, therefore, weaken the current through the primary of the coil C. Or the disconnecting of the plate may diminish the capacity effect with relation to the primary of the latter coil to such an extent that the current through it is diminished, though the potential at the terminal T_1 of the induction coil may be the same or even higher. Or the result might have been produced by the change of phase of the primary and secondary currents and consequent reaction. But the chief determining factor is the relation of the self-induction and capacity of coil C and plate P_1, and the frequency of the currents. The greater brightness of the filament in Fig. 15*a* is, however, in part due to the heating of the rarefied gas in the lamp by electrostatic induction which, as before remarked, is greater when the suspended plate is disconnected.

Still another feature of some interest I may here bring to your attention. When the insulated plate is disconnected and the secondary of the coil opened, by approaching a small object to the secondary, but very small sparks can be drawn from it, showing that the electrostatic induction is small in this case. But upon the secondary being closed upon itself or through the lamp, the filament glowing brightly, strong sparks are obtained from the secondary. The electrostatic induction is now much greater, because the closed secondary determines a greater flow of current through the primary and principally through that half of it which is connected to the induction coil. If now the bulb be grasped with the hand, the capacity of the secondary with reference to the primary is augmented by the experimenter's body and the luminosity of the filament is increased, the incandescence now being due partly to the flow of current through the filament and partly to the molecular bombardment of the rarefied gas in the bulb.

The preceding experiments will have prepared one for the next following results of interest, obtained in the course of these investigations. Since I can pass a current through an insulated wire merely by connecting one of its ends to the source of electrical energy, since I can induce by it another current, magnetize an iron core, and in short, perform all operations, as though a return circuit were used, clearly I can also drive a motor by the aid of only one wire. On a former occasion I have described a simple form of motor comprising a single exciting coil, an iron core and disk. Fig. 16 illustrates a modified way of operating such an alternate current motor by currents induced in a transformer connected to one lead, and several other arrangements of circuits for operating a certain class of alternate motors founded on the action of currents of differing phase. In view of the present state of the art it is thought sufficient to describe these arrangements in a few words only. In the diagram, Fig. 16 II., shows a primary coil P, connected with one of its ends to the line L leading from a high tension transformer terminal T_1. In inductive relation to this primary P is a secondary S of coarse wire in the circuit of which is a coil *c*. The currents induced in the secondary energize the iron core *i*, which is preferably, but not necessarily, subdivided, and set the metal disk *d* in rotation. Such a motor M_2, as diagrammatically shown in Fig. 16 II., has been called a "magnetic lag motor," but this expression may be objected to by those who attribute the rotation of the disk to eddy currents circulating in minute paths when the core *i* is finally subdivided. In order to operate such a motor effectively on the plan indicated, the frequencies should not be too high, not more than four or five thousand, though the rotation is produced even with ten thousand per second, or more.

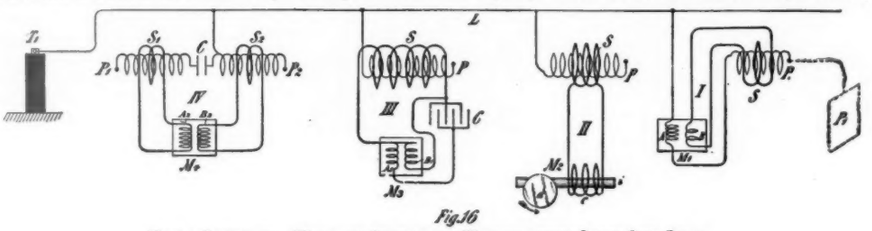


Fig. 16

TESLA LECTURE.—WAYS OF OPERATING MOTORS WITH ONLY ONE LEAD.

In Fig. 16 I., a motor M_1 having two energizing circuits, A and B, is diagrammatically indicated. The circuit A is connected to the line L and in series with it is a primary P, which may have its free end connected to an insulated plate P_1, such connection being indicated by the dotted lines. The other motor circuit B is connected to the secondary S, which is in inductive relation to the primary P. When the transformer terminal T_1 is alternately electrified, currents traverse the open line L and also circuit A and primary P. The currents through the latter induce secondary currents in the circuit S, which pass through the energizing coil B of the motor. The currents through the secondary S and those through the primary P differ in phase 90 degrees, or nearly so, and are capable of rotating an armature placed in inductive relation to the circuits A and B.

In Fig. 16 III., a similar motor M_2 with two energizing circuits A_1 and B_1 is illustrated. A primary P, connected with one of its ends to the line L has a secondary S, which is preferably wound for a tolerably high electromotive force, and to which the two energizing circuits of the motor are connected, one directly to the ends of the secondary and the other through a condenser C, by the action of which the currents traversing the circuit A_1 and B_1 are made to differ in phase.

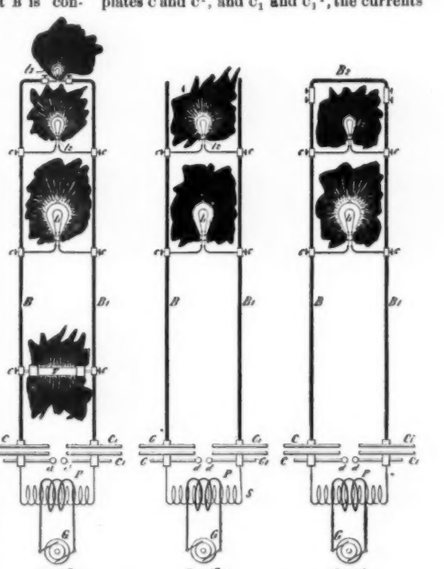


Fig. 19a Fig. 19b Fig. 19c

TESLA LECTURE.—IMPEDANCE PHENOMENA.

In Fig. 16 IV., still another arrangement is shown. In this case two primaries P_1 and P_2 are connected to the line L, one through a condenser C of small capacity, and the other directly. The primaries are provided with secondaries S_1 and S_2 which are in series with the energizing circuits A_2 and B_2 and a motor M_3, the condenser C again serving to produce the requisite difference in the phase of the currents traversing the motor circuits. As such phase motors with two or more circuits are now well known in the art, they have been here illustrated diagrammatically. No difficulty whatever is found in operating a motor in the manner indicated or in similar ways, and although such experiments up to this day present only scientific interest, they may at a period not far distant, be carried out with practical objects in view.

It is thought useful to devote here a few remarks to the subject of operating devices of all kinds by means of only one leading wire. It is quite obvious that when high frequency currents are made use of, ground connections are—at least when the electromotive force of the currents is great—better than a return wire. Such ground connections are objectionable with steady or low frequency currents on account of destructive chemical actions of the former and disturbing influences exerted by both on the neighboring circuits; but with high frequencies these actions practically do not exist. Still, even ground connections become superfluous when the electromotive force is very high, for soon a condition is reached when the current may be passed more economically through open, than through closed conductors. Remote as might seem an industrial application of such single wire transmission of energy to one not experienced in such lines of experiment, it will not seem so to any one who for some time has carried on investigations of such nature. Indeed I cannot see why such a plan should not be practicable. Nor should it be thought that for carrying at such a plan currents of very high frequency are implicitly required, for just as soon as potentials of, say, 30,000 volts are used, the single wire transmission may be effected with low frequencies, and experiments have been made by me from which these inferences are made.

When the frequencies are very high it has been found in laboratory practice quite easy to regulate the effects in the manner shown in diagram Fig. 17. Here two primaries P and P are shown, each connected with one of its ends to the line L and with the other end to the condenser plates C and C^1, respectively. Near these are placed other condenser plates C_1 and $C^1{}_1$, the former being connected to the line L and the latter to an insulated larger plate P_2. On the primaries are wound secondaries S and S_1 of coarse wire, connected to the devices *m* and *d*, respectively. By varying the distances of the condenser plates C and C^1, and C_1 and $C_1{}^1$, the currents through the secondaries S and S_1 are varied in intensity. The curious feature is the great sensitiveness, the slightest change in the distance of the plates producing considerable variations in the intensity or strength of the currents. The sensitiveness may be rendered extreme by making the frequency such that the primary itself without any plate attached to its free end satisfies, in conjunction with the closed secondary, the condition of resonance. In such condition an extremely small change in the capacity of the free terminal produces great variations. For instance, I have been able to adjust the conditions so that the mere approach of a person to the coil produces a considerable change in the brightness of the lamps attached to the secondary. Such observations and experiments possess, of course, at present, chiefly scientific interest, but they may soon become of practical importance.

Very high frequencies are of course not practicable with motors on account of the necessity of employing iron cores. But one may use sudden discharges of low frequency and thus obtain certain advantages of high frequency currents without rendering the iron core entirely incapable of following the changes and without entailing a very great expenditure of energy in the core. I have found it quite practicable to operate with such low frequency disruptive discharges of condensers alternating-current motors. A certain class of such motors which I advanced a few years ago, which contain closed secondary circuits, will rotate quite vigorously when the discharges are directed through the exciting coils. One reason that such a motor operates so well with these discharges is that the difference of phase between the primary and secondary currents is 90 degrees, which is generally not the case with harmonically rising and

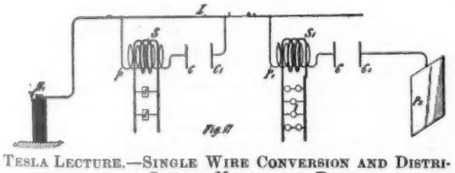


Fig. 17

TESLA LECTURE.—SINGLE WIRE CONVERSION AND DISTRIBUTION, WITH SIMPLE MEANS FOR REGULATING THE EFFECTS.

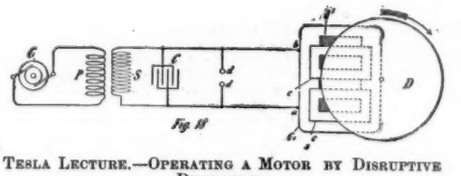


Fig. 18

TESLA LECTURE.—OPERATING A MOTOR BY DISRUPTIVE DISCHARGES.

falling currents of low frequency. It might not be without interest to show an experiment with a simple motor of this kind, inasmuch as it is commonly thought that disruptive discharges are unsuitable for such purposes. The motor is illustrated in Fig. 18. It comprises a rather large iron core *i* with slots on the top into which are embedded thick copper washers *c c*. In proximity to the core is a freely movable metal disk D. The core is provided with a primary exciting coil C, the ends *a* and *b* of which are connected to the terminals of the secondary S of an ordinary transformer, the primary P of the latter being connected to an alternating distribution circuit or generator G of low or moderate frequency. The terminals of the secondary S are attached to a condenser C, which discharges through an air gap *d d*, which may be placed in series or shunt to the coil C. When the conditions are properly chosen, the disk D rotates with considerable effort, and the iron core *i* does not get very perceptibly hot. With currents from a high frequency alternator, on the contrary, the core gets rapidly hot and the disk rotates with a much smaller effort. To perform the experiments properly, it should be first ascertained that the disk D is not set in rotation when the discharge is not occurring at *d d*. It is preferable to use a large iron core and a condenser of large capacity, so as to bring the superimposed quicker oscillation to a very low pitch, or to do away with it entirely. By observing certain elementary rules, I have also found it practicable to operate ordinary series or shunt-direct current motors with such disruptive discharges, and this can be done with or without a return wire.

Among the various current phenomena observed, perhaps the most interesting are those of impedance presented by conductors to currents varying at a rapid rate. In my first paper before the American Institute of Electrical Engineers I have described a few striking observations of this kind. Thus I showed that when such currents or sudden discharges are passed through a thick metal bar there may be points at the bar only a few inches apart which have a sufficient potential difference between them to maintain at bright incandescence an ordinary filament lamp. I have also described the curious behavior of rarefied gas surrounding a conductor to such sudden rushes of current. These phenomena have been since more carefully studied, and one or two novel experiments of this kind are deemed of sufficient interest to be described here.

With reference to Fig 19*a* B and B_1 are very stout copper bars connected at their lower ends to plates C and C_1, respectively, of a condenser, the opposite plates of the latter being connected to the terminals of the secondary S of a high-tension transformer, the primary P of which is supplied with alternating currents from an ordinary low-frequency dynamo G or distribution circuit. The condenser discharges through an adjustable gap *d d* as usual. By establishing a rapid vibration it was found quite easy to perform the following curious experiment: The bars B and B_1 were joined at the top by a low voltage lamp l_3; a little lower was placed, by means of clamps *c c*, a 50-volt lamp l_2 and still lower another 100-volt lamp l_1, and finally at a certain distance below the latter lamp an exhausted tube T. By carefully determining the positions of these devices it was found practicable to maintain them all at their proper illuminating power. Yet they were all connected in multiple arc to the two stout copper bars and required widely different pressures. This experiment requires of course some time for adjustment, but is quite easily performed.

In Figs. 19*b* and 19*c*, two other experiments are illustrated which, unlike the previous experiment, do not require very careful adjustments. In Fig. 20*b*, two lamps, l_1 and l_2, the former a 100-volt and the latter a 50-volt, are placed in certain positions as indicated, the 100-volt lamp being below the 50-volt lamp. When the arc is playing at *d d* and the sudden discharges passed through the bars B B the 50-volt lamp will, as a rule, burn brightly, or at least this result is easily secured, while the 100-volt lamp will burn very low or remain quite dark, Fig. 19*b*. Now the bars B B may be joined at the top by a thick cross-bar B_3, and it is quite easy to maintain the 100-volt lamp at full candle-power while the 50-volt lamp remains dark, Fig. 19*c*. These results, as I have pointed out previously, should not be considered to be due exactly to frequency but rather to the time rate of change which may be great even with low frequencies. A great many other results of the same kind equally interesting, especially to those who are only used to manipulate steady currents, may be obtained and they afford precious clues in investigating the nature of electric currents.

In the preceding experiments I have already had occasion to show some light phenomena, and it would be now proper to study these in particular; but to make this investigation more complete I think it necessary to first make a few remarks on the subject of electrical resonance which has to be always observed in carrying out these experiments.

ON ELECTRICAL RESONANCE.

The effects of resonance are being more and more noted by engineers and are becoming of great importance in the practical operation of apparatus of all kinds with alternating currents. A few general remarks may, therefore, be made concerning these effects. It is clear, that if we succeed in employing the effects of resonance practically in the operation of electric devices the return wire will, as a matter of course, become unnecessary, for the electric vibration may be conveyed with one wire just as well, and sometimes even better, than with two. The question first to answer is, then, whether pure resonance effects are producible. Theory and experiment both show that such is impossible in Nature, for as the oscillation becomes more and more vigorous the losses in the vibrating bodies and environing media rapidly increase and necessarily check the vibration, which otherwise would go on increasing forever. It is a fortunate circumstance that pure resonance is not producible, for if it were there is no telling what dangers might not lie in wait for the innocent experimenter. But to a certain degree resonance is producible, the magnitude of the effects being limited by the imperfect conductivity and imperfect elasticity of the media, or, generally stated, by frictional losses. The smaller these losses, the more striking are the effects. The same is the case in mechanical vibration. A stout steel bar may be set in vibration by drops of water falling upon it at proper intervals; and with glass, which is more perfectly elastic, the resonance effect is still more remarkable, for a goblet may be burst by singing into it a note of the proper pitch. The electrical resonance is the more perfectly attained, the smaller the resistance or the impedance of the conducting path and the more perfect the dielectric. In a Leyden jar discharging through a short stranded cable of thin wires these requirements are probably best fulfilled, and the resonance effects are therefore very prominent. Such is not the case with dynamo machines, transformers and their circuits, or with commercial apparatus in general in which the presence of iron cores complicates or renders impossible the action. In regard to Leyden jars with which resonance effects are frequently demonstrated, I would say that the effects observed are often *attributed* but are seldom *due* to true resonance, for an error is quite easily made in this respect. This may be undoubtedly demonstrated by the following experiment: Take, for instance, two large insulated metallic plates or spheres which I shall designate A and B, place them at a small distance apart and charge them from a frictional or influence machine to a potential so high that just a slight increase of the difference of potential between them will cause the small air or insulating space to break down. This is easily reached by making a few preliminary trials. If now another plate—fastened on an insulating handle and connected by a wire to one of the terminals of a high tension secondary of an induction coil, which is maintained in action by an alternator (preferably high frequency)—is approached to one of the charged bollers A or B, so as to be nearer to either one of them, the discharge will invariably occur between them; at least it will, if the potential of the coil in connection with the plate is sufficiently high. But the explanation of this will soon be found in the fact that the approached plate acts inductively upon the bodies A and B and causes a spark to pass between them. When this spark occurs, the charges which were previously imparted to these bodies from the influence machine, must needs be lost, since the bodies are brought in electrical connection through the arc formed. Now this arc is formed whether there be resonance or not. But even if the spark would not be produced, still there is an alternating electromotive force set up between the bodies when the plate is brought near one of them; therefore the approach of the plate, if it *does* not always, actually, will, at any rate, *tend*, to break down the air space by inductive action. Instead of the spheres or plates A and B we may take the coatings of a Leyden jar with the same result, and in place of the machine, which is a high frequency alternator preferably, because it is more suitable for the experiment and also for the argument, we may take another Leyden jar or battery of jars. When such jars are discharging through a circuit of low resistance the same is traversed by currents of very high frequency. The plate may now be connected to one of the coatings of the second jar, and when it is brought near to the first jar just previously charged to a high potential from an influence machine, the result is the same as before, and the first jar will discharge through a small air space upon the second being caused to discharge. But both jars and their circuits need not be tuned any closer than a basso profundo is to the note produced by a mosquito, as small sparks will be produced through the air space, or at least the latter will be considerably more strained owing to the setting up of an alternating electromotive force by induction, which takes place when one of the jars begins to discharge. Again another error of a similar nature is quite easily made. If the circuits of the two jars are run parallel and close together, and the experiment has been performed of discharging one by the other, and now a coil of wire be added to one of the circuits whereupon the experiment does not succeed, the conclusion that this is due to the fact that the circuits are now not tuned, would be far from being safe. For the two circuits act as condenser coatings and the addition of the coil to one of them is equivalent to bridging them at the point where the coil is placed, by a small condenser, and the effect of the latter might be to prevent the spark from jumping through the discharge space by diminishing the alternating electromotive force acting across the same. All these remarks and many more which might be added, but, for fear of wandering too far from the subject, are made with the pardonable intention of cautioning the unsuspecting student, who might gain an entirely unwarranted opinion of his skill when seeing every experiment succeed; but they are in no way thrust upon the experienced as novel observations.

In order to make reliable observations of electric resonance effects it is very desirable, if not necessary, to employ an alternator giving currents which rise and fall harmonically, as in working with make and break currents the observations are not always trustworthy, since many phenomena which depend on the rate of change may be produced with frequencies widely different. Even when making such observations with an alternator one is apt to be mistaken. When a circuit is connected to an alternator there are an infinite number of values for capacity and self-induction which, in conjunction, will satisfy the condition of resonance. So there are in mechanics an infinite number of tuning forks which will respond to a note of a certain pitch, or loaded springs which have a definite period of vibration. But the resonance will be most perfectly attained in that case in which the motion is effected with the greatest freedom. Now in mechanics, considering the vibration in the common medium—that is, air—it is of comparatively little importance whether one tuning fork be somewhat larger than another, because the losses in the air are not very considerable. One may, of course, enclose a tuning fork in an exhausted vessel and by thus reducing the air resistance to a minimum obtain better resonant action. Still the difference would not be very great. But it would make a great difference if the tuning fork were immersed in mercury. In the electrical vibration it is of enormous importance to arrange the conditions so that the vibration is affected with the greatest freedom. The magnitude of the resonance effect depends, under otherwise equal conditions, on the quantity of electricity set in motion or on the strength of the current driven through the circuit. But the circuit opposes the passage of the currents by reason of its impedance and, therefore, to secure the best action it is necessary to reduce the impedance to a minimum. It is impossible to overcome it entirely, but merely in part, for ohmic resistance cannot be overcome. But when the frequency of the impulses is very great, the flow of the current is practically determined by self-induction. Now self-induction can be overcome by combining it with capacity. If the relation between these is such that, at the frequency used, they annul each other, that is, have such values as to satisfy the condition of resonance and the greatest quantity of electricity is made to flow through the external circuit, then the best result is obtained. It is simpler and safer to join the condenser in series with the self-induction. It is clear that in such combinations there will be, for a given frequency, and considering only the fundamental vibration, values which will give the best result with the condenser in shunt to the self-induction coil; of course more such values than with the condenser in series. But practical conditions determine the selection. In the latter case, in performing the experiments one may take a small self-induction and a large capacity, or a small capacity and a large self-induction, but the latter is preferable, because it is inconvenient to adjust a large capacity by small steps. By taking a coil with a very large self-induction, the critical capacity is reduced to a very small value, and the capacity of the coil itself may be sufficient. It is easy, especially by observing certain artifices, to wind a coil through which the impedance will be reduced to the value of the ohmic resistance only and for any coil there is, of course, a frequency at which the maximum current will be made to pass through the coil. The observation of the relation between self induction capacity and frequency is becoming important in the operation of alternate current apparatus, such as transformers or motors, because by a judicious determination of the elements the employment of an expensive condenser becomes unnecessary. Thus it is possible to pass through the coils of an alternating current motor under the normal working conditions the required current with a low electromotive force and do away entirely with the false current, and the larger the motor the easier such a plan becomes practicable; but it is necessary for this to employ currents of very high potential or high frequency.

(To be continued.)

Unsolved Problems that Edison is Studying.

BY E. J. EDWARDS, IN "M'CLURE'S MAGAZINE."

"I have long been satisfied," said Mr. Edison, referring to his contemplated plans for the future, "that it was possible to invent an ore-concentrator, which would vastly simplify the prevailing methods of extracting iron from earth and rock, and which would do it so much cheaper than those processes as to command the market. Of course, I refer to magnetic iron-ore. . . . I worked very hard on this problem and in one sense successfully, for I have been able by my methods to extract this magnetic ore at comparatively small cost, and deliver from my mills pure iron bricklets. . . . I had some ten important details to master before I could get a perfect machine, and I have already mastered eight of them.

"As soon as the ore-concentrating business is developed and can take care of itself, I think I shall turn my attention to one of the greatest problems that I have ever thought of solving, and that is, the direct control of the energy which is stored up in coal, so that it may be employed without waste, and at a very small margin of cost. Ninety per cent. of the energy that exists in coal is now lost in converting it into power. . . . Now, that is an awful waste, and even a child can see that if this wastage can be saved it will result in vastly cheapening the cost of everything which is manufactured by electric or steam power. In fact, it will vastly cheapen the cost of all the necessaries and luxuries of life, and I suppose the results will be of mightier influence upon civilization than the development of the steam engine and electricity have been. It will, in fact, do away with steam engines and boilers, and make the use of steam power as much of a tradition as the stage coach now is."

Mr. Edison looks further ahead than this campaign, for he said: "I think it quite likely that I may try to develop a plan for marine signaling. . . . I should use the well-known principle that water is a more perfect medium for carrying vibrations than air, and should develop instruments which may be carried upon sea-going vessels, by which they can transmit or receive, through an international code of signals, reports within a radius of, say, ten miles."

Mr. Edison believes that Chicago is to become the London of America early in the next century, while New York will be its Liverpool, and he is of opinion that very likely a ship canal may connect Chicago with tide water, so that it will itself become a great seaport.

The Telephone Girl.

Does it ever occur to any one of many men, that he is daily taking part in a strange proceeding that was never indulged in up to a few years ago? Nearly every day he is conversing with a person whom he does not see, perhaps never did nor never will see. And yet the conversation is as purely a matter of course as his conversation with his wife at the breakfast table.

The particular reference is to the Telephone Girl, that Sweet-Voiced Mystery at the Other End of the Wire, that Desirable Unknown, and Tantalizing Incarnation of Thouartsonearness and Yetsofarness.

There are others unknown with whom one converses in the course of a busy day, but they are nothing compared with the Electric Goddess of whose material charms we wot not, but whose voice is like the thrumming of an elfin harp on a star-lumed night in June, or the tinkling of the lily bells that call the fairies to their revels, or the murmur of a crystal brook gliding over pebbly bottoms in a sun-filled meadow.

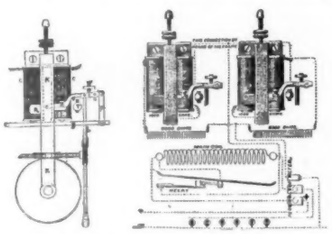
But we know not her Identity; we wonder who is she, when the 'phone vibrates click-clickety with whirring and with whiz. Implore of her to call her name, she merries at our bellow; with laugh like pour of molten pearls she answers only "Hello"!—*Toronto News.*

The Pentz-Reckenzaun Electric Meter.

BY JAMES A. PENTZ.

About the year 1881 Professors Ayrton and Perry constructed a meter and published results based upon the difference in registration of two clocks, one of which was fitted with a magnet in lieu of the ordinary leaden or brass bob weight, the arc of the swing taking place over a solenoid coil, through which circulated the current to be measured. Shortly after this Dr. Aron brought out the meter which is associated with his name, and is exceedingly well known. In this form the registration which represented the measured consumption of electricity was given on a dial, the difference in time between the two clocks being taken mechanically by differential gearing, thus simplifying the use of such a meter, and reducing the necessary calculations which resolved themselves into multiplying the reading by a constant to obtain ampere hours, or assuming constant pressure on the supply mains' units. Recognizing the difficulty of all clock meters which Professors Ayrton and Perry discovered, Messrs. James A. Pentz and Anthony Reckenzaun designed instruments with the view of freeing them of all the weaknesses which were inherent in such clock meters. This involved several years experimenting and assiduous attention, until the instrument, presently to be described, reached its present commercial efficiency. Some of its main features are that the meter contains no spring, no loose hanging pendulums, no clock-work arrangements, no escapements, and yet it is a perfect timekeeper, owing to the force of gravity being utilized for actuating the oscillating bars.

The latest thing in any line always creates some stir, and when it has the merit of being



FIGS. 1 AND 2.—DETAILS OF THE PENTZ-RECKENZAUN ELECTRIC METER.

fresh, is received with favor on the possibility of its being to some extent a solution of the problem. In this respect the Pentz-Reckenzaun meter embodies items of construction which strikes one as being novel and ingenious. It must be borne in mind that it is not a mere modification of meters based upon the Ayrton and Perry principle, but upon a lengthy and independent experience, and certainly is in appearance likely to inspire confidence.

The replacement of escapement spring clocks by electro-gravity synchronized pendulums, the double pendulum, metal case and slate base, but most important of all, the exemption of the clocks from driving any gear and reducing them to simple governors, their proper function, will rank as advances.

The necessity in older types of meter for the clocks to supply the power required by the differential gear militated against their recording with the accuracy which, in principle, the system was capable of attaining.

The new meter requires no attention in the way of winding, being driven by current taken from the supply. The cost of maintenance and driving should be small, and as an extremely low current only is used in the driving magnets, somewhere about $\frac{1}{10}$ of an ampere, many of the existing objections raised to the employment of a potential circuit in a meter do not apply to this. The recorded value can be given directly in units, and the adjustments allowed in the design with this end in view will be dealt with below. The permanent magnet meter is, of course, restricted in its employment to direct current circuits, but a similar adaptation is in view to render such a meter of use for alternate current work. The consensus of opinion points to a greater unanimity of opinion between the supplier and the client as to the value of the electricity consumed than in those instances where the more simple direct supply is in question. The meter of the future is one which will register correctly. It does not necessarily follow that it will be very simple in conception or in actual construction, for supply companies can well afford to pay more for a reliable register of

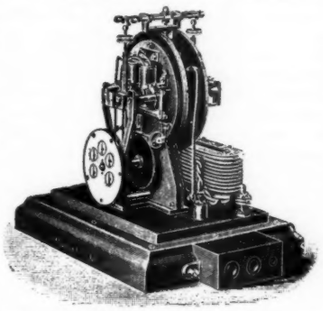


FIG. 3. — SHOWING PENTZ-RECKENZAUN ELECTRIC METER WITH CASE REMOVED.

consumption, but both parties will require a fair arbiter. To return to the subject of our article. The mechanism in the meter may be considered under three heads: First, the standard metronome; secondly, the electrically influenced pendulum and its gear; and, lastly, the recording and indicating apparatus. The electro-magnetic driving apparatus and the pendulum bar of one side of the meter are shown in Fig. 1, while the side view of the pendulum is given in Fig. 2. Fig. 3 shows the connections of the meter in a circuit, and introduces the relay which closes the driving circuit when the meter is in action. When a current circulates in the main coil, owing to a demand on the consumer's premises, the magnetic needle of the relay is deflected, closing the driving circuit and starting the pendulums. As the arrangement of both pendulums is electrically similar, it will only be necessary to trace the course of the current in Fig. 1, which represents half of the mechanism, to understand the action of the meter. The bar, K, is insulated from the frame and is connected to one end of the electro magnet coil C. The other end of the coil C is taken to the negative side of the lamp circuit, through a resistance of 5,000 ohms, and the potential terminal on the right-hand side of the principal terminals, which is connected to the other side of the circuit by a small, well insulated wire. The positive side of the circuit is made through the relay to the frame of the magnets, and thereby the contact screw enables the current to flow to the pendulum bar, thence through the coils and the route described. At the moment the current is turned on, the armature, D, will be attracted, and consequently the pin, H, on the lever, E, will fall, permitting the full weight of the gravity piece, J, to drop upon the cross piece, R, which is a lateral extension of K, and thus the latter is started into vibration. When the end of the gravity piece strikes the stop, T, the driving circuit is broken by R, leaving the screw, S; the armature D, therefore, immediately falls, and in so doing, resets the pin, H, to its first position, being limited in its upward movement by the stop screw, W. On the pendulum swinging back, the cycle of operations is again repeated, and this continues so long as the relay needle is deflected by current passing through the main coil. The driving power of the metronomic systems is, therefore, obtained by the force of gravity, which acts upon a definite mass free to fall a given distance, and is, therefore, independent of the variation in driving current due to fluctuations in the voltage on the mains. The registration is effected by causing the dependent catch bar, L, to actuate the ratchet wheel shown on Fig. 1, so that for every complete swing of the bar, K, a tooth in the wheel is moved forward and the swing registered upon the recording apparatus.

The arbor of one clock being hollow allows the arbor of the other one to be brought through it. The former carries the dials on a frame, the latter a wheel which gears into one on the frame, so that if the two axles revolve together the relative position of a pointer fixed to the wheel carried by the frame, and a point on the dial itself is unaltered. When, however, one axle is given a higher rate than the other, the difference is indicated by a displacement of the pointer and by suitable counting gear the registration of consumption is affected.

Such sparking as might occur with the small current broken periodically at S, has been practically eliminated by a special compound-winding of the magnet coils. The bar, R, and screw S, are at different radii from center of vibration of K, so that a rubbing contract is insured in preference to merely the butt contact which might foul slightly after a period of use under practical conditions. The main coil, through which passes the current to be measured, is a solenoid of special shape and very low resistance.

It is placed with its center below the point of suspension of the magnetic pendulum, whose rate of vibration it accelerates positively by virtually increasing the effect of gravity upon the bar. The relay needle underneath the main coil is deflected by less than the current required by one lamp, and so starts the clocks, which cease to register when the current is switched off.

The adjustments are threefold, the first and second being only attempted by the makers, while the third is open to the meter testers of supply companies. For synchronizing the two bars and timing their vibratory beats, two nuts are arranged on screwed extensions of the pendulums, while the fine adjustment is given by slight variation in height of contact screw S. These two means enable meters to be calibrated so as to start registering without difficulty, maintain straight line curves, and read directly in units.

If, however, the standards of makers and consumers vary, a final adjustment can be made by raising or lowering the main coil, which is mounted on screwed legs with leveling and back nuts for this purpose. No tampering can occur when the meter has been passed for service, as two covers are used, the first covering up the mechanism and being sealed by the local inspector, while the second contains the three terminals only, the access to which would be open to the supply company, but sealed by them to prevent unauthorized interference. The case of the meter is of japanned metal, fitting air-tight to the base. The parts are mounted on a slate base set within a cast metal frame for strength, while the supporting frame work of the parts is utilized as magnetic shields, screening the driving gear of the clocks from one another, and from the magnetic pendulum, which is given every surrounding possible to secure accuracy.

The meter question is daily increasing in importance to electricity supply companies. The capital locked up in such apparatus, and its direct bearing upon revenue account, are being felt practically, and no less are consumers, as a class, interested in the means by which their bills are ascertained.

Without trespassing on controversial grounds, or wounding the susceptibilities

FIG. 4.—THE PENTZ-RECKENZAUN ELECTRIC METER.

of manufacturers, there seems to be a growing record of experience on the meter question, which must have great influence in deciding the "fittest" in type which will be the lucky one to "survive."

Meters with electrolytic matter or fluid contacts seem to be burdened with the weight of their own responsibility and prone to diseases purely electrical, from which their more mechanical brethren are exempt. Indeed, the mechanical principle is slowly but surely triumphing all along the line, and is, step by step, displacing the very beautiful, but less suitable, electro-chemical, thermo-electric and purely electro-dynamic arrangements, for the loss of which few beyond the interested parties will feel any sorrow.

These meters are manufactured by "The Pentz-Reckenzaun Electric Company," whose offices are at 1001 Chestnut street, Philadelphia, Pa.

ELECTRIC RAILWAY AND POWER NOTES.

The Lowell, Lawrence and Haverhill electric railway has negotiated a mortgage for $1,900,000.

The electric railway from Olean to Allegany, N. Y., is an assured fact. The poles are being set and a supply of ties and rails have been received and more are on the way. The road will be a great boon to both places.

The borough council of Clifton, Pa., at a special meeting last week, granted permission to the Philadelphia & Media Electric Railway to lay tracks on Baltimore avenue. The company is required by the ordinance to pave the street from curb to curb, and keep it in repair, as well as lay Belgian blocks in the gutters.

Everything is in readiness for completing the South Mountain Railroad from the Schuylkill to the Susquehanna River, through the counties of Berks, Lebanon and Dauphin, Pa. Work will be commenced this week on the section between Reading and Bernville. The greater part of the road-bed has been completed from Bernville to Grantville, Dauphin county.

A quick trip in electric railroading was made by car No. 8 on the Waterville & Fairfield, Me., Railroad last week. There were seven passengers aboard and the car made four stops besides slowing up six or seven times for frogs and crossing. Notwithstanding all this time the car covered the four and one third miles from Fairfield to the "Plains" in just an even 10 minutes.

It has been stated the Fonda, Johnstown and Gloversville, N. Y., Railroad, recently bought by H. Walter Webb, has fallen into the hands of the Cayadutta Electric Railroad Company, a rival railroad. The transfer papers were signed at the office of Mr. Webb in New York. By the deal, Mr. Webb is reported to have made $170,000 in a few months, while William Littauer, of New York, makes $100,000.

The interests of the people of Portland, Conn., in relation to an electric road in that city, are being carefully watched, and it is not improbable that electric cars will be in use on the street within a year. An application for a charter has already been made, and certain developments are being awaited before an action is taken. It has been suggested that the Hartford line of electric cars, now running to Glastonbury, may be extended to Portland.

The stockholders of the new Beverly and Danvers, Mass., electric railway, to be run by storage batteries, met last week for the election of officers and an operating committee. Hon. John I. Baker was the stockholders' choice for president. John S. Baker was elected secretary, and Peter E. Clark, treasurer. The committee to operate the road will consist of the officers and the following gentlemen: Perry Collier, Sidney W. Winslow, Gilbert P. Tapley, Calvin Putnam and Chas. G. Hardy. The road will no doubt be controlled by the Lynn & Boston Company which so largely controls the street railway service around Boston.

A working model of a new system of automatic electric railway signaling has been exhibited in London. The train in passing depresses a spring rail and makes contact with a relay. The relay makes and holds down a contact, which pulls on a semaphore. A weight of two tons is required to depress the rail, which cannot easily be tampered with by hand, nor is it affected by plate layers' trolleys. The pull is comparatively small as the semaphore arms are balanced. Risk of sticking from snow, wind or other causes, is guarded against by an ingenious device which prevents a further signal being lowered before the first signal comes well home to "danger." Numerous contingencies are automotically provided for, and the invention seems well worthy the attention of railway men.

ELECTRICAL REVIEW

Published at 13 Park Row,
P. O. Box 3329. NEW YORK.

EDITOR:
CHARLES W. PRICE.

ASSOCIATE EDITORS:
STEPHEN L. COLES.
ROBERT H. READ.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.
1546 "CORTLANDT," TELEPHONE CALL.

BOSTON OFFICE:
H. G. TUCKERMAN, Room 29, 620 Atlantic Ave.
CHICAGO OFFICE:
MERWIN J. BULKLEY, 435 "The Rookery."
WASHINGTON OFFICE:
GEO. C. MAYNARD, 1409 New York Ave.

ADVERTISING DEPARTMENT,
H. T. RICHARDS, Manager.

SUBSCRIPTION TO THE
ELECTRICAL REVIEW.

One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 5.00
Single Copy, - - - - - - - .10

NEW YORK, JUNE 24, 1893.

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Electric fan motors are enjoying an especially large sale this year, although the sultry season has not fairly commenced. We are of the opinion that there are yet many unenlightened citizens who would be interested in purchasing these cooling comforts did they know of them. It lies with the manufacturer to make his products known, so that his agent will not be talking of unknown wares when he is endeavoring to effect sales. The moral is obvious.

The advent of the storage battery cars again in New York city will be hailed with pleasure If the Waddell-Entz Company—the storage battery manufacturers—are able to fully convince the street car owners of the efficiency and economy of their system New York may yet have electric traction. There are ten of these storage battery cars now in daily use on Second avenue, between Ninety-sixth and One Hundred and Twenty-seventh streets. Developments will be awaited with much interest.

Accidents will happen in the best regulated shops, and electrical manufactories are no exception to the rule. Granting this, we suggest that it would be in the line of wisdom and humanity if two or three men in every shop were instructed in the rudiments of medicine and surgery, such as the policemen and firemen in most of our large cities are required to learn. Cinders, dust and iron filings will fly in the eyes, a thumb may be crushed in the gearing, carelessness may lead to a bad cut and the severing of an artery, and a hot day may prostrate several workmen. If there is available even one man who can apply a temporary relief when any of these things occur, it will certainly prove two things: First, that suffering is relieved; and second, that the employer has sufficient regard for the employé to provide such relief. The first cost of such a plan is trifling compared with the results, which will include, moreover, a kinder and better feeling between capital and labor.

The attention of inventors is called to this plaintive appeal from residents of Walnut Hills, a suburb of Cincinnati:

"Wanted—Some kind of electrical device to attach to flowers and plants, to prevent half-grown boys stealing them from our yards."

At the May meeting of the French Academy of Science, M. Morssan laid before the members specimens of rare metals produced by the voltaic arc. Instead of employing, as in his first trials, a 300 volt 50 ampere dynamo, he now uses an arc of 60 to 70 amperes and 1,000 volts. Among these specimens (each weighing about 200 grammes) M. Morssan showed the metals tungsten, molybdenum, zirconium and vanadium. All of these are able to absorb large quantities of carbon; vanadium, for instance, absorbs up to 25 per cent. It is also extremely hard, and easily cuts glass and rubies. By employing the same process, M. Morssan was enabled to produce the vapor of silicium and zirconium, which quickly condenses in drops upon vitreous surfaces. May we expect that further researches in this direction will result in the isolation of more elements?

D'ARSONVAL'S HIGH POTENTIAL CURRENT TESTS WITH MICROBES.

Some time ago (May 6, '93, p. 141) the ELECTRICAL REVIEW gave to its readers a detailed description of M. D'Arsonval's tests with high potential currents upon objects placed inside of the secondary of a powerful inductorium. It was stated that the experimenter employed currents of extremely high frequencies, *i. e.*, 800,000 oscillations per second, but in spite of the very powerful induced current no changes could be noticed in the objects upon which the experiments were made.

Our readers also remember certain tests made by Mr. Edison and others upon animals. In his experiments Edison desired to find out whether or not an extremely strong magnetic field had any influence upon animal life. The evidence, so far adduced, was to the contrary.

Recently Messrs. D'Arsonval and Charrin have studied the influence of high potential currents upon microbes. Up to the present there existed among scientific people very divergent opinions concerning this subject, and, indeed, only a few experimenters have given careful attention to this important question. Messrs. D'Arsonval and Charrin selected as the object of their experiment one of the best known bacilli, bearing the classical name "bacillus pyocyanicus."

A culture of this bacillus was placed in a glass tube inside of the above mentioned secondary of the inductorium and at once subjected to powerful induced currents of 10, 20 and 60 minutes duration. At the end of the test two drops of this culture were removed and placed in a second tube containing gelatine or some similar substance, and this tube placed in a vapor bath.

The subsequent microscopic examination disclosed the fact that all of the bacteria were alive and multiplying regularly. No change of form could be noticed, and all pathogenic functions remained unchanged, but it was found that their secretive pigment had altered. While the first two test tubes revealed a distinctly blue coloration under the microscope, the last two showed a rather pronounced greenish tinge. In other words, the induced current had produced a change in color, which demonstrates the fact that electricity acts upon living cells or micro-organisms. This discovery explains why the electrical condition of the air has much to do with the growth or development of epidemic germs. Messrs. D'Arsonval and Charrin conclude that the electrical condition of the atmosphere necessarily affects the vitality of human tissue, if not directly, certainly indirectly by furthering or retarding the growth of bacteria.

The influence of thunderstorms upon certain fermentive germs is well known, for example lactic ferment. It is certain that this new discovery will be of great importance in the study of bacteriology.

LETTERS FROM A LABORATORY.—L.

BY JULIAN A. MOSES.

The great prominence which has been given to the recent murder trials has brought out many theories and conjectures which would otherwise have lain dormant awaiting suitable moments for their expression.

The slightest movement of the accused both before and during the trial is of the utmost importance, and that the truth be fully established is naturally essential to the honest conduction of the case. Unfortunately stage tricks and underhand measures have been resorted to in order to conceal the true condition of affairs, and they have often been of great assistance to the prisoner, and conversely in many cases a great help to the prosecution.

Generally these court officials are wonderful character readers, and can often tell almost at a glance whether the prisoner be guilty or innocent. Ofttimes, however, a prisoner maintains such a stolid indifference to the proceedings that the prosecution is at a loss to know whether the position assumed by the accused is the result of a hardening caused by a thorough familiarity with crime, or a feeling engendered by conscious innocence. This latter quality is likely to be assumed by experienced criminals which keeps the prosecutors upon their guard, and puts many difficulties in the way of the unjustly accused to prove their innocence.

Any means then that will, with a certain degree of positiveness, either confirm or disprove a suspicion, should be welcomed as an aid to the furtherance of justice. Such means are, however, rare since it must be only from the inner consciousness of the individual that the true facts of the case can be obtained. As yet no apparatus has been devised that will indicate one's thoughts graphically in all cases; but not long ago an incident occurred during a trial in Europe which shows how contact with criminals and experience with shrewd and designing persons will sharpen one's ingenuity.

It appears that a most horrible murder had been committed in a usually quiet little village. The husband of the victim was suspected, and although there was no direct evidence against him, for some reason best known to himself, the prosecuting attorney seemed positive that the accused was guilty. Throughout the trial the prisoner assumed an air of indifference, holding the arms of his chair as if to steady himself, and it was impossible for the most delicately trained eye to detect any change in his countenance or attitude during the examination of the witness who gave the most damaging testimony against him. He simply held onto the arms of the chair and evinced no feeling. All of a sudden a bright idea seemed to strike the mind of the prosecuting attorney, who held a hurried conversation with the presiding judge, which resulted in a postponement of the trial for three days. This unusual procedure, no cause being given, astonished those assembled, but at the expiration of that time the trial was continued, which resulted in the confession and conviction of the murderer who would have otherwise undoubtedly escaped.

The following, as related to me by one who claims to have been instrumental in the conviction, is the ingenious manner in which the guilt of the prisoner was determined:

The prosecuting attorney had noticed the way in which the prisoner grasped the arms of the chair, and he, therefore, resorted to the aid of electricity as a means of informing him of the thoughts of the prisoner.

It is a well known fact that under intense mental excitement, no matter how outwardly calm the individual may be, the hands will involuntarily contract and relax according to the intensity of the emotion and the susceptibility of the person affected. Thus when the prisoner felt the truth of the facts elicited during the examination an invisible contraction of the muscles of the hands resulted, which only the arms of the chair could feel, and this was the manner in which the arms of the chair, were rendered communicative. During the absence of the prisoner from the court room the prosecuting attorney removed the arms of the chair, split them in half and inserted a hard carbon plate in each, which served as a variable resistance. Wires were now run from metal plates placed on either side of the carbon through the legs of the chair and under the floor to a telephone receiver and battery placed in an adjoining closet. The arms were again upholstered and the chair replaced. Every increase in pressure on the arms of the chair, in the act of squeezing them, affected the carbon which, acting as a transmitter, caused sounds to be issued from the mouth of the receiver. When the trial was resumed a court official was placed in the closet, and by a series of signals arranged upon beforehand, signified the feelings of the prisoner, as they were evinced through the muscles of his hands. The main points against the prisoner thus determined, were formulated and read to him in privacy, which resulted in his being overcome and in his making a subsequent confession.

CORRESPONDENCE.

OUR BOSTON LETTER.

Work on the New Electric Light Station, at Marlboro, Mass., is progressing rapidly, and the station will probably be in running order within the next three weeks.

At the Last Annual Meeting of the Thomson European Electric Company, held at Portland, Me., on June 15, the following directors were elected: Oliver Ames, S. E. Peabody, N. Smith, B. F. Spinney, Prentiss Cummings, S. P. Messervy, H. D. Hyde and Francis Peabody, Jr.

The Branch Line to Bay State of the Northampton, Mass., Electric Railway Company is being laid very rapidly. The machinery for the power house is arriving and the building will be started at once. It will be built entirely of brick, and will be divided by a thick brick partition into two compartments, one for the engines, the other for the dynamos.

The Stockholders of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., have voted to double the present capital stock of the company, which is $100,000, and the additional $100,000 will be paid in between August 1 and March 1 next. The business of the concern is increasing very rapidly, and a considerable extention of their plant will soon be necessary.

Work on the New Plant of the Central Electric Railway, of New Britain, Conn., is fast nearing completion. The two large engines which are to furnish power are on hand and waiting to be set up. It is expected that electric cars will begin running between New Britain and Plainville by July 1. The engines are of 500 and 600 horse-power each, and will drive thirteen 500 volt machines.

The "Novak" lamp continues to gain steadily in popularity, and orders for large quantities are now coming in faster than they can be shipped, in spite of the increased facilities at the works. The Waring Company are now turning out nearly 3,000 per day, and reports from the factory show that they are 11,000 lamps behind present orders. Among recent orders was one for 6,000 lamps from one concern.

A Delegation of Saugus, Mass., townspeople visited Melrose last week and appeared before the Board of Selectmen of that town to urge the construction of the proposed electric street railway line from Melrose to Saugus Centre. At the close of the hearing, at which several of the Lynn and Boston management were present, the Melrose Selectmen informed the Saugus delegation that the road would be constructed as soon as possible, and that the hearing had been held to hear remonstrants if any appeared.

Boston, June 17. H. G. T.

WORLD'S FAIR NEWS.

Captain W. L. Candee, of the Okonite Company, Limited, is spending a few days in the city looking after his exhibit at the World's Fair. The Okonite factory have been very busy, and have been delayed in this particular line, but the work is now well under way, and they promise to make a very creditable showing.

Siemens & Halske's Electric Scenic Theatre on the Midway Plaisance was opened Friday last, and is being largely patronized by visitors. All the effects produced are by electricity, power being furnished by motors of the Rockford type. The lights used are of three colors; red, white and blue, which are wired in series, and are of eight and five candle-power. They are operated from a controlling stand consisting of thirty-six switches. The electric apparatus was arranged by Mr. Johann Zacharis, electrical engineer, of Berlin, who will be in charge during the Exposition.

George Cutter's exhibit at the World's Fair is located in the southwest corner of the Electricity Building, where he has on exhibit a fine display of electrical specialties. The space is enclosed by a brass railing, the floors are nicely carpeted, and oak furniture tends to make a very attractive display. The exhibit consists of china switches, plugs, etc., made by Pass & Seymour, of Syracuse, N. Y.; also the many specialties manufactured by Mr. Cutter, including voltmeters, lamp hoods, lamp-holders, etc. These are all nicely arranged on large plates and tend to make the exhibit most attractive.

There is Nothing More enjoyable after one has become weary and footsore viewing the sights at Jackson Park than to take a trip throughout the lagoons upon the boats of the Electric Launch and Navigation Company. The view from the boats of the many buildings which they pass in making the trip is a very beautiful one and it is most pleasant to enjoy the cool breezes while gliding through the water in these clean and noiseless conveyances. Visitors are beginning to appreciate the comforts bestowed upon them through this source, and Admiral Barney stated to the REVIEW representative that although they now had 43 launches in operation he found it would be necessary to put on several more soon to accommodate the public, as the business of the company since June 1 has been constantly on the increase. Tuesday of this week the boats carried 10,000 passengers during the day, which is the largest day's business since the opening. The management is much pleased with the outlook for a good business during the remaining season, and will no doubt realize a good profit from their investment.

The Concessionaires in Midway Plaisance have been making life a burden to Director of Works Burnham this week owing to an order issued by him that the electric lights would be shut off in Midway at 11 o'clock on "open" nights and at 7 o'clock on other nights. The concessionaires who, by the way, were not supplied with lights until a month after the Fair opened, declare that the order of Mr. Burnham simply rubs salt into the wounds. The "off" nights are Mondays, Wednesdays and Fridays. During the past fortnight these nights have been almost as profitable to the concessionaires as the "open" nights, when the park is open to everybody until 11 o'clock. To shut off the lights on off nights, the concessionaires say, would simply give them three nights of business in a week, and precipitate an additional loss which they are scarcely able to stand. They maintain that, inasmuch as Midway Plaisance is no part of Jackson Park, they should be permitted to entertain the people who are turned out of the Exposition grounds proper until such an hour as they see fit to close their doors. They declare that they have paid their money for light, and that it is no more than fair that they should have it when they want it. The concessionaires also declare that the Exposition Company sets aside its own nights for opening, paying no attention to Midway, but seeking to minimize its expense of illuminating the Park proper.

The Intramural Railroad at Jackson Park is now being liberally patronized by visitors at the Fair. At first the road was not a success financially, as people were not aware of the beautiful views obtained of the grounds and buildings while taking a trip over this road, which is six miles in length, and traverses the principal sections of the park. The road carried 18,744 paying passengers Tuesday of last week, which was the largest day's business the road experienced since it opened. Last Saturday's business was 13,056 fares, and Sunday's 12,000. Up to May 30 the road carried a total of 142,511 paying passengers. The service is being increased as rapidly as motor cars can be turned out of the shops. Nine trains of four cars each are now being operated, and trains pass every station, going both ways, every four minutes. The full service of the road will be constituted in 15 trains of 60 cars, with a seating capacity of above 5,000 passengers.

Chicago, June 15. M. J. B.

The James Kempster Outing Club.

The eighth annual outing of the James Kempster Outing Club was enjoyed at Point View, L. I., on June 17. This club is composed of the employés of the James Kempster Printing Company, of this city, which company has done the printing for the ELECTRICAL REVIEW for many years. A feature of the holiday was an exciting exhibition of the National game between teams from the composing and press rooms. The "composers" won by a score of 20 to 14. Mr. Kempster, who always attends these outings, is now in Europe, but was represented by Mr. Hyslop, foreman of the press room, who made a short speech after dinner.

Telephone Affairs in New York City.

The rapidly growing demand for telephonic service in this city of 2,000,000 inhabitants requires constant vigilance on the part of the management of the Metropolitan Telephone and Telegraph Company. There are to-day in use in this city 9,500 telephone sets, and over 100,000 subscribers' connections are made on an average every day in the week. To see that each of these calls is carried to a successful end and to the satisfaction of the subscriber at each end, is a task the nature and difficulty of which it is almost impossible to conceive, and yet by means of modern apparatus and the highest grade of electrical and technical skill, the Metropolitan Telephone and Telegraph Company is enabled to do this so completely and satisfactorily that the day of complaint of telephone service in this city is rapidly passing away. It is daily becoming more and more evident that it is not so much the cost of the service, but its quality that the public are interested in.

The main offices of this company are located at 18 Cortlandt street, where, in its own building, is the largest telephone exchange. The city is divided into eight districts, each containing a central office, and two new offices have been proposed and will probably be constructed during the year, one in Broad street and the other in Franklin street, east of Broadway.

General Manager U. N. Bethell has recently made some changes in the departments of his company with a view to simplifying and expediting the transaction of its very large business. Mr. J. J. Carty, the well known electrical engineer, who heretofore has been electrician of the company, has been made engineer, and will hereafter have charge of all engineering, electrical, civil, etc.

This department reports direct to the general manager, as also does the department of the general superintendent. Mr. E. W. Carrett is the general superintendent, and reporting direct to him are the following named officials: G. C. Allen, superintendent of maintenance; F. V. D. Skillman, superintendent of rights-of-way; R. C. Bethell, superintendent of equipment (inside lines and central offices); E. F. Sherwood, superintendent of exchanges; J. A. Helvin, superintendent of construction (outside lines).

Mr. D. C. Cox is the manager of supplies and Mr. N. W. Leonard the purchasing agent of the company, and John Lenihan, S. B. Brewster and Henry Osborn are special agents of the company, whose duties chiefly consist in securing new subscribers.

There are over 800 officers and employés connected with the Metropolitan Telephone and Telegraph Company, and 400 of these are young ladies employed in the different exchanges. $600,000.00 are paid out annually in salaries.

An Opinion From Mr. Westinghouse.

A Philadelphia dispatch to the Boston *News Bureau* is to the effect that Mr. George Westinghouse, Jr., says the reports of a union of the Westinghouse Electric Company with the General Electric Company are absolutely without foundation. He is satisfied with the business as it is. His company should do a gross business of $10,000,000 this year and more than cancel its $3,000,000 of debt. He is enthusiastic over the outlook for the electric business; declares a cable road an impossibility in Boston's crooked streets and says the trolley is to supersede the cable in Market street, Philadelphia. He says there is no more limit to the development of the electric field than to the steam power field, but that it is now a question only of manufacturing and of manufacturing profits.

Detroit Electrical Works.

The Detroit Electrical Works were sold on June 13, on a foreclosure suit, for $100,000. Hugh McMillan held mortgages to the amount of $200,000. The sale was part of the reorganization plan. They will now be sold to the New York syndicate, who will place $200,000 working capital in the plant.

"The Thrill of a Million Volts."

[Respectfully dedicated to Nikola Tesla, the lion-hearted experimenter with electrical conditions of tremendous energy.]

BY T. BERRY SMITH.

There's a thrill of bliss
In a sweetheart's kiss
At which no man revolts;
But Tesla's found
A happier ground:
The thrill of a million volts.

There's a dreadful gleam
In the fiery stream
Of the lightning's thunderbolts;
But Tesla sees
And takes with ease
The thrill of a million volts.

'Tis one of the joys
Of country boys
To ride on kicking colts,
But the thrills they know
Fall far below
The thrill of a million volts.

And there's a thrill
That is different still,
Best known to drones and dolts;
But the ferule's sting
Is a trivial thing
To the thrill of a million volts.

The pugilist fills
With wondrous thrills
When he gives a blow that jolts,
But this is naught
We're Tesla taught
To the thrill of a million volts.

And a wrestler knows
Ecstatic throes
When he has the "underholt's,"
But for Tesla's arm
There's a richer charm:
'Tis the thrill of a million volts.

Most people quake
At the sight of a snake,
Or even the skin it moults;
But Tesla's heart
Doesn't even start
At the thrill of a million volts.

The jolts of bolts
And of kicking colts,
The ferule's sting to drones and dolts,
All these are naught
We're Tesla taught
To the thrill of a million volts.

Fayette, Mo., June 8.

PERSONAL.

Col. L. W. Burnham, of Boston, looked in on several of his electrical friends of the metropolis last week.

Dr. Frederic A. C. Perrine will marry Miss Margaret Joanna Roebling, daughter of F. W. Roebling, at Trenton, N. J., on June 28.

Mr. Henry Sanger Snow, a well known citizen of Brooklyn, has been elected treasurer of the New York and New Jersey Telephone Company, taking the place of Mr. U. N. Bethell, who resigned to accept the position of general manager of the Metropolitan Telephone and Telegraph Company, of New York city. As one of the first duties performed by Mr. Snow was to subscribe for the ELECTRICAL REVIEW, we know he must be the right man in the right place.

Mr. Harris W. Baker, formerly of Springfield, Mass., will hereafter have charge of the New York office of the Elektron Manufacturing Company, at 89 Liberty street. Mr. Baker is an active, capable young man, and may be expected to push the business of his company in this vicinity in a way that will bring good returns. The Elektron Company is widely known for the excellence of its manufactures, and now that it has actively entered the electric elevator field is sure to win a host of new friends and patrons.

Col. Frank C. Mason, superintendent of police telegraph, Brooklyn, N. Y., and honorary assistant, Department of Electricity, Columbian Exposition, returned last week after a two weeks' sojourn attending to his World's Fair duties in Chicago. Mr. Mason reports the Fair the biggest show on earth, and with his department chief, Prof. John P. Barrett, was enabled to see every branch of it to special advantage. Like others from the east who visit the Fair, Mr. Mason expects to return again and stay longer, and advises all his friends to follow his example.

The Survey for the Pacific Cable.

INTERESTING DISCOVERIES AT THE BOTTOM OF THE OCEAN—HIDEOUS MONSTERS THAT NEVER SEE SUNLIGHT—WIRE LOST IN MAKING SOUNDINGS—FROM MONTEREY TO HONOLULU THE BEST ROUTE—THE BOTTOM OF THE PACIFIC WITHOUT MOUNTAINS AND FAVORABLE—WHO WILL BUILD THE CABLE?

The survey of a lane 300 miles wide over the floor of the Pacific Ocean, between the coast of California and the Hawaiian Islands, has been one of the most interesting scientific tasks ever undertaken by the government. Up to date nothing has been allowed to be published respecting the results obtained. The purpose of the work was to determine the best route for a submarine cable. Two lines of soundings were run by the United States Fish Commission's steamer "Albatross," from Monterey Bay to Honolulu. This path has been decided on as preferable to a road connecting Point Conception, Cal., and Hilo Bay, Hawaii, which was laid out with soundings by the steamer "Thetis," U. S. N. The way selected will require the smallest length of wire. It will pass over an even bottom of soil favorable for the protection and preservation of the cable, avoiding submarine mountains.

Submarine cables suffer much more near shore than in the depths of the sea. In the shallows they are exposed to the chemical action engendered by decaying animal and vegetable matters. The iodine contained in seaweeds destroys iron rapidly. Accordingly, localities which run quickly into deep water, over bottoms of mud or sand, are chosen for landing places at the end of the route. By selecting the gully at Salinas Landing for a starting point, the minimum length of cable will be exposed to damage from such sources, as well as from the anchors of vessels, and from the wear and tear of waves and breakers. In shallow water great injury is done to cables by the bivalve mollusk, called the "toredo" or "shipworm," as well as by a shrimp-like crustacean named "limnoria." The latter is a very small creature, only about one-eighth of an inch long, and covered with minute hairs. But its numbers are so great and the jaws with which it chews are so powerful that it will demolish wooden piles at the rate of an inch of their thickness per annum. Teak is the only wood it does not devour.

In 1859 a hemp-covered telegraphic cable on being raised after hardly a year's submersion, was found covered with countless millions of the toredo and limnoria. The hemp had entirely disappeared under the operations of the mollusk, while the crustacean had pierced the gutta-percha insulating core with ever so many small round holes. In the shallow waters close by Honolulu the temperature is about 77 degrees in winter. This warmth might interfere with the insulating properties of the gutta-percha; on that account it is recommended that india rubber shall be used for the core at the end of the line. Experience has proved that in isolated patches of the sea bottom some agency very destructive to the sheathing wires of cables frequently exist. This is believed to be due to outcrops of veins of minerals, and such localities are avoided whenever it is possible. The action of the salt water would be likely to decompose the mineral substances and forming solutions would attack the metal.

At present a plan commonly adopted is to envelop the gutta-percha core with a bandage of cloth impregnated with stearine. This is designed to prevent galvanic action between the copper wires forming the conductor and the outer armor of iron. The lines of the Eastern Submarine Telegraph Company and the Eastern Extension Submarine Telegraph Company, both of which pass through regions badly infested by the toredo, are protected in this way, and have resisted the enemy well. Instances are recorded in which cables have been bitten by sharks and cut by swordfishes. In one case a break was caused by a whale which got entangled in a loose portion of cable that hung down between two steep slopes. It is important that a cable should lie on the bottom throughout its entire extent.

Incidentally to the soundings, observations were made of the bottom temperatures. Below half a mile in depth, the water of the ocean is intensely cold, remaining both winter and summer at a point only slightly above freezing. The contents of a trawl hauled up from the floor of the sea at the equator will be found to include mud and ooze that is nearly freezing. All of the life in the vast waste of waters called the Pacific is either near the surface or at the bottom. The abyssal fishes cannot live except under the enormous pressure of water—amounting to over two tons to the square inch at three miles down—to which they are subjected. In order that they may be able to endure this, the tissues of their bodies, and even their bones, are very loose in texture. Though solid enough under the conditions to which they are accustomed, they are soft and pulpy when dragged up to the open air. Their eyes protrude, and sometimes they actually burst open.

Such fierce carnivorous fishes as exist in the depths of the ocean are unknown at the surface. There is the "black swallower," which devours other finny creatures ten times as big as itself, literally climbing over its victim, first with one jaw and then with the other. Another species is nearly all mouth, and, having almost no power of locomotion, it lives buried in the soft ooze at the bottom, its head alone protruding, ready to engulf any prey that may wander into its cavernous jaws. There is a ferocious kind of shark resembling a huge eel. All of these abyssal monsters are black as ink. Some of them are perfectly blind, while others have enormous goggling eyes. No ray of sunlight ever pierces the dark unfathomed caves in which they dwell. Each species is gobbled by the species next bigger, for there is no vegetal life to feed on.

The surface of the grayish ooze, over which the cable will run, is an interminable desert where nothing grows. There being no sunlight to support vegetal life, not a blade or sprout of any sort of vegetation is to be discovered—not even a seaweed. Here and there are creatures called "crinoids," which counterfeit plants in the appearance, with waving stems and what look like flowers, but are not such. Also there are seaworms, which live in tubes and resemble the most brilliant blossoms. Spiny seaurchins are plentiful, and over the bottom are crawling shrimp like crustaceans of bright scarlet and vivid orange hues, some of them of great size. There are numerous species of mollusks as well. They and the crustaceans, when hauled to the surface, are so disorganized by the removal of the pressure to which they have been accustomed as to look as if they had been boiled.

The ocean floor across which the cable will be laid is fairly well populated with living species, most of which are unknown to science at present. This remark especially applies to the larger fishes, which could not be fetched up with the trawl. Some day perhaps a more effective method will be devised for capturing them. Nobody can tell what monsters and chimeras dire may inhabit the abyssal regions of the Pacific.

The total length of the lines surveyed by the "Albatross" and "Thetis" between California and the Hawaiian Islands was 6,785 miles. In the sounding operations 179,142 feet of piano wire was lost. Such accidents are unavoidable. The sinker sometimes gets entangled at the bottom, or the vessel gives a sudden lurch and snaps the wire off short. In these ways 469 sixty-pound sinkers were also lost. In shoal water, a rope and lead do well enough for sounding. By filling a small cavity in the base of the lead with tallow, a quantity of the sand, or mud on which the lead strikes, becomes imbedded in the tallow, showing the character of the bottom soil. For soundings in the depths, however, special apparatus must be used. It is not very complicated, consisting chiefly of a sinker and sufficient length of No. 11 music wire. The latter, which stands a strain of 200 pounds, is wound on a wheel. Each turn of the wheel registers a fathom, or six feet, while a dial keeps count of the number of turns paid out. Thus the depth at every sounding is registered automatically. A scale shows the tension on the wire and indicates the instant that the sinker reaches the bottom. The sinker is in part composed of a cylinder which has a valve in its lower end. When it strikes bottom this valve is forced up and the interior of the cylinder is filled with soil from the bottom. At the same moment an automatic thermometer attached to the contrivance notes the temperature of the water.

The government will have nothing to do with the laying of the cable, claims a writer in the *New York World*. The object of its work was merely to discover how far such a plan was practicable and what route was best for the wire to follow. Private enterprise must do the rest. At present an effort is being made to organize a syndicate in California with a view to carrying out the project. It is extremely doubtful whether a line merely connecting California with Honolulu would have enough business to make a profit. But it is thought there would be a great profit in a cable running all the way across the Pacific to Japan or Australia. It is certain that not many years will elapse before the circuit of the earth will be made complete with connecting wires, so that a message can be sent around the globe in the space of a few seconds.

A Remarkable Railway.

If the scheme elaborated by an Italian engineer for the construction of an elevated railway in Naples is carried into execution, Italy will possess one of the most remarkable structures in the world. As far as length is concerned, the projected line is not of great importance, but the boldness of the idea and its originality are very striking. Let the imagination conceive the hilly portion of a town connected by means of viaducts and towers with that part lying at a low level, and the substance of Mr. A. Avena's project will then be readily understood. The handsome and populous part of Naples, radiating from Via Roma, has only communication with the Corso Vittorio Emmanuele, the San Martino hill and the (at a still higher level) new Rione del Vomero by means of narrow, tortuous streets, many of them being impracticable for carriage traffic. It is between these two extreme localities that the proposed electric railway is to form a connection. The line is to be carried on two metallic viaducts, each divided so as to form a double way, one for the operation of electric cars and the other for pedestrians. A masonry tower, 325 feet high is to be built in the Via Roma, and from this the first viaduct, 1,180 feet long, will be carried to the Corso Vittorio Emmanuele, where it will terminate in the base of a metallic tower, 490 feet in height. The second viaduct, 950 feet long and branching out of this tower some distance below the summit, will pass over the San Martino hill and end in the ground level at the new Rione del Vomero. The viaducts will be carried on pyramidical metallic towers having masonry foundations; and the masonry tower at the beginning of the first viaduct and the metallic tower, connecting the two viaducts, will each be provided with staircases and capacious lifts for conveying passengers up and down. Passengers entering the cars at either end of the line will not be compelled to change their seats on arriving at the metallic ower, as the cars will be automatically placed on the lifts for ascending to or descending from the highest viaduct, when the cars will continue their way to either terminus. Generating stations will be provided at each terminus for producing current for lighting and power purposes. The undertaking, a concession for which has been granted, would provide a splendid view of the whole of Naples.

The Chester, Darby and Philadelphia Electric Railway expect to award the contracts for building and equipping their road along Chester pike this week.

New German Electrical Patents.

SPECIALLY ABSTRACTED BY DR. H. ZERENER, BERLIN, FOR THE "ELECTRICAL REVIEW."

20 P 6180. Contrivance for automatic signalizing by electric railways. T. M. K. Pennink and F. C. Dufour, in Amsterdam.

74 M 9300. Electric contrivance for signalizing noises at distant places. Charles Ambrose McEvoy, in Manchester.

74 W 8241. Contrivance for electric translation of hand positions. L. Weber, professor in Kiel.

21 B 14429. Hanging contrivance for translated arc lamps or groups of arc lamps. H. Bartels, in St. Johann-Saarbrinkey.

21 L 7842. Constructing of electric plates for accumulators. Henry Herbert Lloyd, in Philadelphia.

48 E 3794. Contrivance for electrolytic preparing of vessels in the manner of shells. Elmore's German and Austro-Hungarian Metal Company, Ld., in London.

85 S 7014. Fountain with electric illumination by means of colored sheaves. Paris, Eugene Singer, in London.

21 L 6996. Preparing of filling mass for galvanic elements. D. M. Lamb, in Boston.

21 R 7238. Preparing of carbons for arc lighting. Dr. Rickmann C. Rappe, in Kalk of Köly on Rhine.

21 M 8373. Solenoid for equal attraction of cylindric core. Addition to patent B 1179. Wenzel Robert Michl, in Wetter, A. D. Ruhr.

21 M 9213. Building of electrode plates for accumulators. Adolph Müller, in Hagen, Westphalen.

21 S 6851. Proceeding for increase of capability to speak through long subterranean and submarine cables.

21 Sch. 8613. Regulating contrivance for reversed current. Schuskart & Company, in Newinberg.

21 Sch. 8678. Closing contrivance of galvanic elements. Otto Spiess, in Berlin, Sw.

21 V 1803. Proceeding of movement of conductible liquids through polyphasal currents. Ernst Albin Vogler, in Bulleritz, in S.

21 V 1923. Electro-magnet. Richard Varley, Jr., in Englewood, New Jersey, U.S.A.

4 F 6418. Electric priming apparatus for miners' lamps. P. Fischer, in Schweidnitz.

21 K 9876. Adjusting contrivance. Walter H. Knight, in Newton, Middles., Mass., U. S. A.

21 E 3375. Accumulator, whose electrodes consists of sheets with crossed waves or ribs. Ch. P. Eiteson, in London.

21 H 12538. Electric exciter acting through induction. William Henry, in Detroit, Mich., U. S. A.

21 P 5979. Fixing of ends of binding screws and of incandescent fibres in the glass bulbs. Martha W. Pollard, in East Cambridge, Mass., U. S. A.

21 S 6793. Loose coupling for electric conduits. Alexander Shiels, in Glasgow, Scotland.

75 S 6782. Anode for electrolytic treating of salt solutions. W. Spilker, in Berlin.

21 Sch 8223. Regulating contrivance for electric arc lamps. Frederick Thomas Schurds, in Bradford, Grafschaft, York, England.

48 H 13376. Electric preparing of hollow perforated metallic cylinder. C. G. Haubold, Jr., in Chemnitz.

48 S 6455. Improvements in the apparatus for preparing of metal wires and metallic bands by means of electrolytical process. Richard David Sanders, in Eastbourne, Sussex, England.

Last week, in the United States Circuit Court, of Pittsburgh, Pa., Judge Acheson handed down an opinion in the suit on the American Bell Telephone Company *vs.* the McKeesport Telephone Company, granting the preliminary injunction asked for against McKeesport Company, and other defendants who are citizens of Pennsylvania. Judge Acheson in his opinion refers to the fact that the patent has been sustained a number of times by the Supreme Court, and that in this case it is not claimed that there is any material difference in the telephones in question. The Bell patent expires on the 30th of next January.

The Deptford Central Station.

FROM A LONDON CORRESPONDENT.

The expectations cherished four or five years ago concerning the electrical and commercial prospects of the Deptford generating station of the London Electric Supply Corporation have not been realized, and the present condition of affairs tends to show that it will be a long time before the difficulties experienced at and in connection with the station are overcome. It was originally believed, by erecting large works and concentrating in them huge machinery on the Ferranti high tension 10,000 volt system, for the supply of hundreds of thousands of lamps, that excellent electrical and commercial results would be obtained, and that a considerable number of customers would be secured. These anticipations have, however, proved to be unfounded. To say the least, the position of the undertaking from the beginning has been most unfortunate. The operation of the two 5,000 horse-power dynamos has been abandoned, perhaps for a long time to come, whilst the two machines of 1,250 horse-power are not without drawbacks. The plant at work at the present time consists of the two 1,250 horse-power dynamos, two of 625 horse-power which have been remodeled and their output increased from 8,500 to 12,500 lights each, and a new dynamo of 300 horse-power, driven by a set of triple expansion engines, which have recently been put down. Another machine of 300 horse-power will shortly be installed. These 300 horse-power dynamos will enable the day load to be worked with greater economy, and they will constitute a useful auxiliary power, as they can be worked in parallel with the larger machines with considerable economy. The trunk mains have proved satisfactory during the past year, and the length of the distributing mains has been increased to 35 miles. As showing how great a reduction has been effected in the cost of producing a Board of Trade unit, it may be mentioned that in 1891 every unit produced cost 10.14 pence, of which, 4.61 pence comprised generation—that is, coal, sundry stores, repairs and maintenance—coal alone costing 2.36 pence per unit. In March, 1892, the total cost had been reduced to 8.06 pence, and in March this year the cost was diminished to 5.71 pence, of which, coal represented 1.31 pence per unit for that three months. It is hardly possible that the price of coal will fall—the probability is rather that it will advance, considering the adverse influence affecting the coal market; but the other items, bringing up the total cost to 5.71 pence, are practically stationary and will be reduced in proportion to an augmentation in the number of lamps lighted.

Thus, even with an increase of twice as many lamps as are now connected, the only extra expenses to be incurred will be mainly in the case of coal, so that with the practically stationary cost per unit (4.40 pence). In the case of the other items, the total cost of producing a unit will be diminished in proportion to the increase in the number of lamps connected to the mains, and, therefore, in the number of units sold.

The misfortunes, breakdowns and fires attending the undertaking have caused a great alteration in the number of lamps supplied. For instance, in November, 1890, at the time of the fire at the Grosvenor Gallery distributing station, there were 88,272 lamps connected. As the supply was thereby stopped, these customers ceased to be consumers, and a beginning had again to be made. In May, 1891, however, 23,000 lamps had again been put on circuit; at the commencement of 1892 the number had increased to 35,100 lights, and at the end of the same year to 46,197 lamps, whilst down to the middle of May of the present year the number has been advanced to 56,200 lamps. If the same rate of progress during the past two years continues in the next two years, it is expected that the undertaking will be out of trouble. The plant at Deptford is now capable of dealing with 90,000 lamps, the transmission from there to the transformer distributing stations being effected at 10,000 volts. In this connection it is surprising to note how very considerable is the loss of current by leakage, especially in conversion. For instance, of the total current generated and put into the mains—the distance of transmission being between four and five miles—only from 42 to 45 per cent. has been accounted for, the whole of the remainder of from 55 to 58 per cent. having disappeared! Fortunately, the causes, one being energy losses in house transformers, have been discovered, and to remedy the defects new transformers are being introduced which will increase to 70 per cent. the utilization of the total current generated.

As Mr. J. Staats Forbes, the chairman of the corporation, recently remarked, the undertaking was started on too magnificient an idea, and that the practical conclusion of many people was that it would have been wiser to have commenced with a smaller unit instead of having two dynamos of 5,000 horse-power and two of 1,250 horse-power. However, by the remodeling of and improvements made in the machinery, transformers and switching gear, by the present more economical method of working, and by the increasing confidence of the public in the ability of the corporation to maintain an efficient supply of light, it is hoped that the undertaking will retrieve its position, and emerge from an unsatisfactory state into one of comparative prosperity in the course of two or three years. Whether these hopes will be fufilled concerning what was onec termed "the largest electricity works in the world" remains to be seen; but, at all events, it is gratifying to find that a little progress is being made in the right direction.

Chinese Telegraph Lines.

Recently telegraphic connection has been established between the Chinese station in Helampo and the Russian station in Blagowesttschensk, across the frozen surface of the Amur river. As soon as the weather moderates it is intended to replace the existing line across the river by a cable, and to connect with it several other Chinese lines.

A retrospect upon the development of the telegraph in China may be of interest at this time. As early as 1865 some Russian firms approached the Chinese government concerning the connection of several Chinese lines with the then existing Siberian telegraphic system. The Chinese government, however, turned a deaf ear to all such propositions, considering them in the light of dangerous novelties. As a consequence, the Great Northern Telegraph Company, in 1871, laid a cable from Wladiwostok to Nagasaki, Shanghai, Futschau, Amoy and Hong Kong. This cable was landed in such cities as were friendly to foreigners without going to the trouble of getting the permission of the proper Chinese authorities. It was thought best to show these gentlemen a *fait accompli*, instead of going through the labyrinth of Chinese etiquette. Thus the cables were landed and the stations constructed without any grant from the government, and the official permit was only recently obtained.

The first attempt on the part of the Chinese government to establish telegraphic service was made in 1870. This took place in South Formosa, where the first line was built, between Taiwanfu and Takao, a distance of 50 km. After this first experiment the government constructed, in 1883, a line of considerable length between Shanghai and Tientsin. Thereafter, the ice being broken, the government made rapid strides, and at the present time, with the exception of two provinces, *i. e.*, Hunan and Honan, the vast territory is well covered. But in these two provinces the inhabitants are so hostile to any modern improvement, that it was found impossible to construct a line.

It should be stated that nearly all of the existing Chinese telegraph lines have been built by Danish engineers, and as a rule, by employés of the Great Northern Telegraph Company, but the administration of the lines and the service is entirely in the hands of the government. As the Chinese telegraphers are obliged to understand English, messages in English characters may be sent throughout the empire.

Of course, the mass of the people have very queer notions about the telegraph. For example, one intelligent Chinese was noticed to watch the telegraph wires for an entire day. When asked why he watched the wires so closely, he replied, that he desired to see a message pass through them, but that he had not succeeded so far. The latest news is the proposed construction for line between Sutschan, Kaschgar and Tamir.

A Simple Experiment.

To obtain those luminous tube effects which created so much non-technical bewonderment last year, Mr. Nikola Tesla employed a whole armory of appliances, including a special high frequency alternator, oil transformers and special magnetic interrupters. Mr. Nikola Tesla no sooner showed us how to do the thing in an elaborate manner than, as is invariably the case, every one was showing every one else how to obtain similar effects by the most simple contrivances. The limit in this direction appears, however, to have been reached by M. P. Marsillac, who, in *La Lumiere Electrique* for April 22, described the following rudimentary arrangement.

M. Marsillac employs three Lalande and Chaperon cells of the French telegraph pattern, a Ruhmkorff coil 10 centimetres long by three inches diameter, with an extra sensitive trembler break, and a thin glass Geissler tube 10 or 15 centimetres long. With this toyshop apparatus, M. Marsillac is able to reproduce one of the most striking of Mr. Tesla's experiments. Shades we had all known increased the effective illumination obtainable from a given source of light, but when the historic Thursday evening, at the Royal Institution last year, Mr. Tesla applied a shade to one of his single wire glow lamps, the candle-power of the lamp went up as well as the candle feet on the table below, we seemed to be getting dangerously close to perpetual motion in the shape of an indefinitely large amount of light derived from an indefinitely small source of power. It is this pretty electrostatic experiment that M. Marsillac reproduces with the simple appliances above mentioned. He connects one terminal of

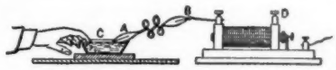


FIG. 1.—A SIMPLE EXPERIMENT.

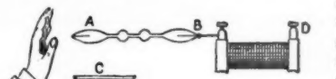


FIG. 2.—ANOTHER EXPERIMENT.

the tube to one terminal of the coil, as shown (Fig. 1), having previously filed down the other tube wire, and dips the free end of the tube into a little china dish, C, resting on a sheet of ebonite, and containing either pure water, salt water, sulphate of copper, etc. On dipping the finger into the liquid the tube commences to glow. Once started in this way, the glow persists even if the finger is withdrawn from the liquid. On lifting the tube out of the liquid (Fig. 2) and bringing the hand up close to it, the glow also continues.—*London Electrician.*

The American Traveler and Tourist Company.

The American Traveler and Tourist Company has established offices at 849 Broadway, near Fourteenth street (formerly occupied by the Pennsylvania Railroad Company), which will be in charge of Mr. H. M. Haines, a well known railroad man of this city. Mr. Haines has handled a great many special trains over the Pennsylvania Railroad for electrical people, and is one of the most obliging men in the business. His new company is the authorized agent for the principal American and foreign railway, steamship and steamboat lines, and tickets can be secured there for all parts of the world.

The ELECTRICAL REVIEW is pleased to call attention to this new company and wishes it every success.

The directors of the American Bell Telephone Company met on June 14 and declared the regular quarterly dividend of $3 and an extra dividend of $3, both payable July 15 to stockholders of record June 30. Transfer books close from July 1 to July 15, inclusive.

TELEPHONE CHAT.

Considerable excitement was caused in Cincinnati the other day when a swarm of bees took possession of an awning in front of the telephone exchange.

The New England Telephone and Telegraph Company began the work of stringing new wires between Greenfield and Brattleboro, Vt., last week.

The new telephone system in McKeesport, Pa., has been enjoined for alleged infringement of the patents of the Bell Company, and cannot be used, pending the judicial investigation.

The telephone line between East Stroudsburg and Bushkill, Pa., will soon be in working order; the poles are nearly all set, and the company is rapidly pushing the work to completion.

The city council of South Bend, Wash., has granted a 25 year franchise to the Sunset Telephone and Telegraph Company for the establishment of a telephone exchange in that city. The telephone system must be in working order in 90 days. The poles are cut and the cars are loaded at Tacoma with wire and apparatus, which will be shipped at once.

The telephone offices at Cincinnati have been moved into the new building on Vine street and the work of equipping the new exchange room is going on night and day. The new switchboard is of the automatic self-restoring drop type, which will be used ultimately in all the larger exchanges. Captain Stone hopes to move the exchange on August 1 and expects to have complete long distance connections in operation by October 1.

Through the enterprise of General Superintendent E. B. Baker, of the Southern New England Telephone Company, every telephone in Bridgeport, New Haven and Hartford, Conn., will be on a metallic circuit before the end of the year. Before July 1 every telephone in Middletown will be metallic. Superintendent Baker is having the systems of New Britain and Norwich entirely rebuilt at the present time, and when finished everything will be in metallic circuit. The company has just purchased a lot on Bank street, Waterbury, and will erect there a new exchange and also lay underground wires.

Telephonic Intercommunication by Means of the Water and Gas Systems of a City.

A correspondent of the French journal, *Genie Civil*, states that there is quite a noticeable difference of potential between the gas and water pipes of the city of Paris. To get a sharp click, it is sufficient to connect one wire of a telephone to a faucet and then touch any of the adjacent gas pipes with the other telephone conductor. A galvanometer connected between the two pipe systems proves that the gas pipe is the negative pole of this battery; furthermore, the needle is not only deflected, temporarily, but remains deflected for months. The experimenter has demonstrated the existence of such a difference of potential in a great many houses in Paris, as well as in the open country, and he attributes such current to the fact that both gas and water pipes are the electrodes or plates of a battery of enormous size.

However that may be, it occurred to the investigator to practically use this current for telephonic intercommunication. He succeeded in transmitting a message between two houses situated several hundred metres apart. In this experiment he employed a microphone without an induction coil, energized by three bichromate batteries. It is stated that every one may easily make a practical test. In fact, by employing a small induction coil, connected by one terminal to a water pipe and then touching with the free end any of the neighboring gas pipes, a sharp click will be heard, in a telephone similarly connected to the pipe system, in almost any of the houses within several blocks. It is pointed out that should the experimenter fail to transmit articulate sounds, he can thus send more signals without any line whatever.

Electrolytic Action of Heavy Currents on Water and Gas Pipes.

To the Editor of Electrical Review:

The following is an abstract of a paper read by Mr. C. H. Morse, inspector of wires, Cambridge, Mass., on "Electrolysis of Water Pipes":

When the Cambridge Railroad Company put in their power plant, they ran large numbers of feeders, as we call them, and one wire between the rails, and attached the two rails to this return wire so that the current would go to the car through the motor wheels, to the rails, and get along as best it could to the station. This became very soon an uncertain path, as it was found that electrolytic action took place upon this wire and it disappeared in places. They thought at first that it was due to something in the soil, but it was very soon traced to the same enemy which you have to contend with, that is, electrolytic action. I remember the practical experience we had with these dead rails, as we call them. When this wire was eaten off and a car came on to that section, if by chance you placed one foot upon the rail and another upon the ground near it, shocks could be obtained. That happened simply in this way: The current must go back to the station, and it would take to the rail, which was not well grounded, would go up one leg of the man who stood on the rail and down the other to the earth, especially if the earth was a little moist. The effect was so great that the West End Railroad Company made a complete change and reversed the conditions. . . . That is, they attached the other pole to the earth to remedy this difficulty, and instead of sending the current out over the feeders, they commenced to force it out through the ground, have it go up through the cars and back through the feeders.

Mr. Nevons and I went to the different places where we had traced these difficulties, and found that lead pipes had disappeared in a short space of time, some even in six or eight weeks. Iron pipes had been tried with the same result, also galvanized iron; brass pipe had been put in and deterioration was noticed at once. Rustless iron was tried, and it did rust decidedly. Well, it was not the work of any mysterious agent, but was the result of what almost all of you have seen in school experiments; that is, the decomposition of water. The current left the West End power house at East Cambridge, it flowed through the ground, and, of course, divided according to the resistance, and took to whatever conductor came in its way. It took to the rails, the water pipes and gas pipes. Now we get no action except at what we call the positive pole. That is where the current is flowing out of the pipes; where it takes to the pipe there is no action. The current flowed along on the pipes, and in this particular case it got down onto Bridge street, which is near Charles river, and flowed along our supply pipes on the wharves, and here it had to get across the river to propel the cars in Boston. Where it left those pipes action took place.

Mr. Morse goes on to state that the loss from this leakage was not confined to the destruction of pipes, but that the electric company sustained heavy loss of power, amounting to from 25 to 45 volts out of a maximum pressure of 500 volts. He estimated the loss of power in another instance at about 20 per cent.

The effect of reversing the current led to a new difficulty. "We then hurt one of our old friends seriously—that is, the gas company," says Mr. Morse. "The current will flow on the water pipes, and it has an easy chance to leave them through their connection with the negative pole of the dynamo. Now it flows along on the gas pipe, and as soon as it can it will leave the gas pipe to take to the water pipe." Then, of course, it sets up electrolytic action in the gas pipes. The essayist asks: "How are we to remedy the difficulty?" and answers: "I know of no way by which we can use the single trolley wire system and overcome this difficulty without putting up an immense amount of overhead returns, through which the resistance will be reduced to almost nothing."

In March last I sent in a communication relative to the electrolytic effect of return wires of electric car systems, which at that time had not, to my knowledge, been observed or commented upon by either news or technical papers. Since then much attention has been given the matter, but even now the electricians seem very slow to appreciate the situation and lacking in such an understanding of fundamental principles as would enable them to deal successfully with the matter.

The Cambridge plan of "reversing" the wires and feeding the car dynamo through the ground wire is not a scintillation of genius. In wet ground in electrical contact with tide water the loss of power would not be "20 per cent.," but of the whole difference between the resistance of the ground wire and that of the wet earth. It would be very much like running a steam engine with the back pressure in the exhaust pipe.

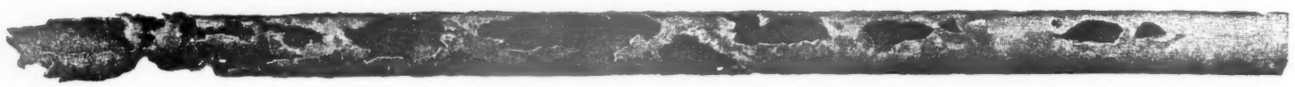
The stringing of "so many return wires that the resistance will be reduced to almost nothing" would be equally futile, as regards saving power, though the water pipes would be left unharmed. The resistance in the return wire has already been reduced to so much less than nothing that it acts electrically upon every conductor in contact with it, even setting up destructive induced currents in the gas pipes lying near to the water pipes with which the ground wire is connected; if the "many" overhead return wires are strung the *shortage* of electrical energy is simply distributed among them, reducing the (negative) electrical tension somewhat.

The Cambridge Inspector of Wires, Mr. Morse, like all the rest who had referred to the matter, whose reports I had opportunity to observe, has made the mistake of supposing that the return wire lacked capacity to carry the electrical energy back to the dynamo. The very opposite is the truth. A certain measurable amount returns through the ground wire, but it is less than that sent out. What becomes of the difference? It passes off into space when breaking of circuit makes sparks, it leaks into moist air, and it is wasted in burning iron or copper in those many and beautiful blue and green sparks. The dynamos in the power house call upon the return wire for that wasted electricity and the dutiful return wire gets down upon its metaphorical knees and begs electricity from the water and gas pipes, from the earth and the air and the sky—and what won't come willingly is dragged forth with force, to the damage of water and gas pipes.

I am somewhat jealous of my reputation for a little scientific knowledge not adulterated with a vague belief in "physchic" forces to run street cars nor faith in "mental telepathy" as a method of ordering stove castings. I am not an expert electrician, nor familiar with the terminology and nomenclature which has grown up with the late tremendous electrical developments, but if I have failed to impress you with the idea that I know something of the ground plan of electricity, you can brush the conceit out of me, and that's good for me even if it wastes a little of your time. Granting your favorable impression, there is room for a very good letter regarding the "reverse wire" effects in this locality.

Cromwell Galpin.

Los Angeles, Cal., June 6.



Electrolytic Action of Return Current on Wrought Iron Water Pipe.

Electrolysis of Water and Gas Pipes.

The recent trouble with water and gas pipes, caused by the detrimental electrolytic action of currents from trolley lines, seems to be heard of from all parts of the country. The accompanying illustration from *Progressive Age*, shows what was once a two-inch wrought-iron coated service pipe. This piece was removed from the street immediately in front of the power house of the trolley railway at Battle Creek, Mich. The Short system is the one in use, and has been in operation about 18 months. Evidently the life of water pipes in the vicinity is of extremely short duration, for it is easily seen that in order to produce such extensive wasting away in that time, the disintergrating action of the current must have commenced at an early date. It also seems that as yet there are no pipes which will withstand the effect of the return current, whether they be galvanized, tar-coated or of the so-called "rustless" variety. There is a chance for the inventor who will produce a pipe free from this difficulty.

Effects of Electricity on the Growth of Plants.

Some most valuable additions to the data available in regard to the new science of electro culture, or the cultivation of plants by electricity, have been made by Brother Paulin, as the results of a series of experiments conducted scientifically. These experiments have extended over the last two years. Finding that electricity exerted a favorable influence on vegetable life, Brother Paulin devised what he called a "geomagnetifere" for the purpose of attracting what electricity is found near the earth in consequence of meteorological phenomena, such as storms, rains, wind, etc , and distributing it in the ground in the vicinity of the roots of plants. The geomagnetifere is a resinous pole, ranging in height from 40 to 60 feet, which is planted in the ground and which supports, by means of porcelain insulators, a galvanized iron rod, that terminates in five copper points; these points project prominently from its top. This collecting brush is connected by means of the rod with a system of wires six feet and nine inches apart, which distribute the electricity in the ground which it is proposed to influence. The area depends upon the height of the pole. An area of, say, 3,588 square yards, for example, is allowed a pole 49 feet 2 inches high. The wires are buried a depth of 6 to 18 inches in the ground and will last for many years, in fact until they are destroyed by rust. The first experiment made by Brother Paulin was conducted in the spring of 1891 in a potato field belonging to a farmer in the suburbs of Montbrison, France. A report was published in the following July which drew special attention to the marked irregularity in the vegetation in the field which has been brought under the influence of the current. It said: "In an exact circle in which the electric conductors are buried, the potato plants have a growth double that in the rest of the field. And this is true without exception; there is no gap in the groups of plants forming a circle almost as exact as if it had been drawn by a compass." The Agricultural Society, of Montbrison, regarded the results attained of such importance as to entitle Brother Paulin to a special medal. The report of the committee shows that the operations of the geomagnetifere extended over an area of 65 feet 5 inches in radius. In this part of the field the stems of the potato plants attained an extraordinary size and development and preserved at the same time a freshness that contrasted very favorably with those in neighboring parts of the field. The stems were measured and were found to reach a height of 57.87 inches and .787 inches in diameter. Four patches of ground, which represented the average vegetation in both parts of the field, were selected, two of which were traversed by the wires, while the other two were not subjected to the influence of electricity. The 32 meters in the former area yielded 198 pounds of potatoes, while the same area in the uninfluenced portion of the field produced 124 pounds. The production per hectare (2.47 acres) in the first case would be 61,600 pounds and in the second 41,140 pounds. This result, attained without any special fertilizing and with a common variety of potatoes, equals the best crops obtained at large expense with chemical fertilizers.

Doesn't Apply to 13 Park Row.

"It is true the editor rejected my poem," said Stanzer, "but I know it wasn't the fault of the verses."

"What was it, the editor's stupidity?"

"No. I knew I was hoodooed when I got into car No. 13 and found I had to pay my fare to a cross eyed conductor."—*New York Truth.*

Electrical Nomenclature as Viewed in England.

In a recent issue we noted the rapid progress made in the United States by the Crocker-Wheeler dynamos and motors, these specialties having attained such a ready sale for ventilation and general power purposes that the company was forced to build fresh works in order to keep up with requirements. The new works are of sufficient size to form a small community in themselves, and being in a district hitherto uninvaded by the builder, they have had to undergo the process of naming.

To show that abstract units do not represent the only possible method of glorifying dead scientists, the new centre has been called "Ampere," thereby improving very considerably upon the want of system which ran riot years ago in the naming of American towns, and led to the establishment of Rome, Utica, Troy, Syracuse, and other classical localities hobanob with Indian villages, and all within a few hours' ride of one another.

We shall probably have the next World's Fair held at "Voltaville"—a city to rank higher than any ordinary New Yorks and Chicagos, and which will be reached by way of "Faraday Junction," "Ohmlands," and "Kelvinside."—*London Electrical Engineer.*

Running With a Human Trolley.

The novel sight of a man taking the place of the trolley on an electric car was seen last night on the Lake Roland Elevated Railway. The trolley on one of the large electric cars, in crossing Lexington street at North street, had its trolley wheel caught in the wire, and the entire trolley apparatus was torn off, falling to the street. The accident happened at a time when travel over the road was heavy, and it was necessary to prevent a blockade.

Lineman William Scott was equal to the occasion. He procured a piece of insulated wire, and after stripping each end of the insulating material connected one end through the car roof and standing on the top of the car held the other end against the trolley wire. A connection being thus made the car was run over the elevated structure to the car barn at Walbrook without accident to Mr. Scott or delay to the other cars. Mr. Scott's position was a novel one and startled persons who are unused to electricity, as he stood on top of the car amid myriads of sparks and illuminated by lightning-like flashes from the trolley wire.—*Baltimore Sun.*

Subways in Stockholm.

Plans and surveys have recently been made in connection with projected subways under the streets of Stockholm for sewage, gas and water pipes, wires for telephones and electric lighting, etc. At present these are distributed below the surface without any fixed plan, and their repairs give the usual trouble and inconvenience. It is, however, evident, from the local conditions, Stockholm being to a great extent built on rock, with many steep streets and numerous waterways, that the difficulties, both technical and financial, will be almost insurmountable. The subways of London and Paris have been examined, also the conditions of Berlin, where there are no subways, and the result has been arrived at that it is always a most difficult task to construct subways in an old town—that, in fact, such subways should be constructed almost simultaneously with the laying out of new streets. As far as Stockholm is concerned, the subways must be confined to certain streets, where, in some cases, the tunnels will have to pass through solid rock, and it is possible that the scheme may be attempted only in a fragmentary manner.

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week.

New Electric Railways.

EASTON, PA. — The Easton and Bangor Electric Railway Company; capital, $100,000. Length, 16 miles, from Easton to Bangor, Pa. Incorporators, J. M. Young, T. M. Lesher, J. P. Correll, D. W. Nevin, Easton, Pa.; and Geo. G. Snyder, Mt. Pleasant, Pa.

OTTAWA, CAN. — The Kneewatin Power Company has been chartered, with a capital of $1,000,000, to furnish electric power from the Winnipeg river. The directors are William Gibson, John Mather, Richard Fuller and Alexander Fraser.

NEW HAVEN, CONN.—The State Street Railroad Company will build an electric power house at River and Ferry streets.

CEDARVILLE, N. J. — The citizens have voted, unanimously, in favor of a trolley road.

FREDERICK, MD.—A movement is on foot to build an electric line from Gettysburg, Pa., by way of Emmitsburg and Frederick, to Washington.

MUNCIE, IND. — A new electric railway scheme is being perfected for the building of a line from Muncie to Eaton, a distance of 12 miles. James Pixley and George Reed are interested.

KINGSTON, N. Y.—The Colonial City Electric Railway Company; capital, $175,000. Incorporators, Wendell Goodwin and Frederick Swift, of New York city; Hasbrouck Alliger, of Rondout; Alvan S. Newcomb, Charles W. Deyo, E. G. Lawrence and Elbert G. Loughran, of Kingston. The company will build an electric street railway, six miles long, in Kingston.

POTSDAM, N. Y.—The Racket River Railway Company has been incorporated with a capital of $350,000, for the purpose of building a standard gauge road, to be operated by steam or electric power, from Potsdam to Pierpont and Colton and Parrishville, 20 miles. The directors are W. Wickham Smith, William Wills, Foster L. Backus, A. L. Chatterton and Geo. R. Crossley, of Brooklyn; R. L. Russell, of Buffalo, and A. R. Dodge, of New York city.

MIDDLETOWN, N. Y.—The Middletown-Goshen Traction Company; capital, $100,000. Incorporators, B. F. Low and A. D. Seaman, of Middletown; E. G. Wightman and B. H. Throop, of Scranton, Pa., and Samuel Harris, of Cleveland, Ohio. The company will build a street railway, about ten miles in length, in Middletown.

HOOSICK FALLS, N. Y. — The Hoosick Railway Company; to construct an electric railroad, about four miles in length, from Hoosick Falls to Walloomsac; capital, $60,000. Incorporators, Joseph Buckley, S. D. Locke and W. M. Holmes, of Hoosick Falls; G. C. Moses and F. H. Twitchell, of Bath, Me.

MAHANOY CITY, PA.—The Mahanoy City and Shenandoah Street Railway Company; capital, $600,000. Incorporators, F. Bailey, D. D. Phillips, Joseph P. Eagan and MacHenry Wilhelm. The company will operate an electrical line between the points named.

BENTON HARBOR, MICH.—The Benton Harbor and Southern Railroad Company, capital, $30,000, has been incorporated. The officers are: Milton Mercer, president; Aaron Zook, secretary; and Harvey V. Mercer, treasurer. The company will build a 30-mile electric railway from Nappanee, Ind., to the State line in Berrien County.

KNOXVILLE, TENN.—The Robinson Southern Electric Railway Company, with headquarters in Knoxville, has applied for a charter to construct an electric railway from Knoxville to Kingston, Popular Creek coal mines, Andersonville, Clinton, Maynardsville, Blamor's Cross Roads and the Little Tennessee river. The incorporators are: W. Baright, L. D. Dillon, B. H. Sprankle, A. J. Robertson, J. S. Stewart, J. S. R. Murphy and others.

Electric Light and Power.

GOUVERNEUR, N. Y.—The village trustees have granted a conditional franchise for the construction of an electric light system to G. P. Hart.

CHICAGO, ILL.—The City Illuminating Company has been chartered with a capital of $6,000, to produce light for illuminating buildings, and to generate and distribute electrical currents for the operation of motors, etc. The incorporators are M. B. Austin, R. H. Watson and H. W. Ames.

JAMESTOWN, N. Y.—The Jamestown Consumers' Arc Light and Power Company has been formed for the purpose of utilizing the water power known as the Dexterville dam, for the generation of electricity.

MARTINSVILLE, IND.—The electric light and power company of this city has assigned. Assets, $17,000; liabilities, $10,000. The Central Thomson-Houston Electrical Manufacturing Company is a creditor for $6,500, and will be the principal loser.

COLORADO CITY, COLO.—The Colorado City Glass Company will erect an electric light plant. The company has the contract for public lighting.

CHESTER, PA.—The Chester Electric Lighting Company will build an addition and install a large amount of new machinery.

New Telephone Companies.

SOUTH BEND, WASH.—The Sunset Telephone and Telegraph Company has been granted a telephone franchise by the city council.

SAGINAW, MICH.—Orson Millard, of Flint, and John A. Gavitt and David Swinton, of this city, have been granted a franchise to erect and maintain lines of wire, and to erect and maintain a telephone exchange.

DECATUR, ILL.—The Citizens' Mutual Telephone Company, capital, $100,000, has been incorporated by W. J. Kurtz, R. Tobey, O. E. Harris and J. G. Harvey.

New Manufacturing Companies.

NEWARK, N. J.—The Harvey Process Railway Equipment Company; capital, $350,000. Incorporators, Edwin J. Quigley and F. W. Coolidge, of Orange, and Lewis R. Pomeroy, of Chatham.

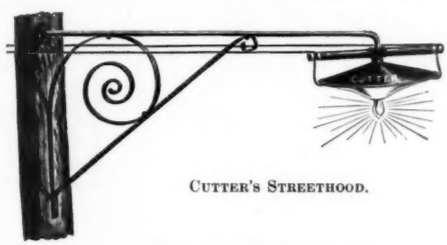
SIOUX CITY, IOWA.—The Sioux City Electrical Supply Company has increased its capital stock from $25,000 to $100,000.

CHICAGO, ILL.—The Novelty Electric Company; capital, $10,000. Incorporators, Howard M. Carter, Edwin G. Lancaster and Charles B. Carter.

Wall Street and the Electrical Market.

The controlling feature in the Wall Street market was the decision of the Clearing House Association to issue certificates against collateral held on loans by individual banks, who are members of the Clearing House. This action, while it was in itself a confession of extreme weakness, was regarded as one of the most beneficial that could have taken place, inasmuch as it completely fortified the banks and placed them in a position to extend further accommodations to their customers. The action came none to soon, as on the morning of the announcement money on call was run up to 25 per cent.

One of the leading stocks of the week, in point of activity as well as advance, was General Electric. The highest figure reached was 75 on Monday; on the same day it sold at 71¾. The advance last week was on the covering of shorts. On Monday Mr. Coombs was responsible for a large part of the decline. He stated that if big men felt entire confidence that the present rate of dividend would be maintained the stock would not be kept at present figures. On Tuesday 70¼ was reached, the lowest price of the week. The stock was weak up until Friday when it rallied to 73⅝ on good buying. The bears are as aggressive as ever on the stock, while there are signs of substantial support from moneyed interests. The vital question regarding the property at the present time is whether the quarterly dividend of two per cent., payable in August, is to be reduced. Several semi-official statements have been made, one coming from Director D. O. Mills this morning to the effect that the company was earning more than it did last year, and that for anything known or foreseen, the full dividend would be paid. Until an official announcement is made regarding this point, or until unmistakable signs of inside support are visible, the stock will continue to range around the present figures. Bets were made the fore part of the week amounting to about $500 that the stock would sell below 55 this year. In a talk with an executive officer of the company a representative of the ELECTRICAL REVIEW learned that the transfer books show surprisingly few transfers considering the volume of transactions. From this the conclusion is drawn that much of the trading consisted of short sales and the covering thereof. Our informant states that there has been no perceptible change in the ownership of the great bulk of the stock.



CUTTER'S STREETHOOD.

An officer of General Electric informed a representative of the ELECTRICAL REVIEW that the company has entered into a contract to furnish the equipment for the Chicago and St. Louis Electric Railway, which is now being built between the two cities. The goods will be supplied on a cash basis, and the company has not or will not interest itself in any way in the stock or bonds of the enterprise.

In Boston, Bell Telephone advanced three points, reaching 193 on Friday on limited sales. Erie Telephone sold in very small lots between 44 and 45. General Electric preferred did not receive a transaction. It was bid 90 to 92 and held at 100. New England Telephone sold 30 shares between 58 and 56. Fort Wayne Electric was bid 8½ and held 9¼.

We publish below our monthly comparative table of prices of electrical, telegraph and telephone stocks. The electrical stocks show more pronounced declines as compared with prices current on May 25 than the balance of the list. Although the decline has been comparatively insignificant.

	May 21.		June 16.	
Electric Light.	Bid.	Asked.	Bid.	Asked.
Con. Electric Storage..	2	3	1	2½
Edison Ill., N. Y.....	113	113	104	106
Edison, Ill., Brooklyn..	108	110	99	102
" " Boston....	144¾	145	129	131
Ft. Wayne Elec. (par 25)	10	10½	9	9¼
General Electric.....	78	78¾	72⅝	73
Mt. Conduit & Ins.....	68	65	20	30
Thom.-Houston, Series C, (par 10).....	6¾	7	6¾	7
Thom.-Houston, Series D.....	6	6¼	6	6¾
Thomson-Houston Int.	242	250	242	250
" " Pfd.	105	108	105	108
Thom. Houston Welding Co.....	59	60	55	60
Western El. L. Consol., (par 50).....	24	24½	25¾	26
Western El. L. Consol., Pfd. (par 50).....	42	42¾	45	46
Telegraph.				
American Tel. & Cable..	80	83	81	85
Cent. & So. Amer. Cable..	....	115	..	115
Commercial Cable.....	135	170	125	170
Franklin Cable.....	35	40	35	40
Gold & Stock	100	103	100	103
Mexican.....	....	200	....	20
Northwest Guar. (par 50)	104½	....	104½	....
Pacific and Atlantic....	50	60	50	60
Postal Telegraph Cable..	....	75	....	75
Southern & Atlan. (par 25)	75	82½	75	82½
Western Union.....	85¾	86	82⅞	83
Telephone.				
American Bell Tel.....	183½	184	189½	190
Erie.....	44	45	45	45½
Mexican (par 10).....	100¢	105¢	90¢	110¢
New York & New Jersey	92½	95	92½	95
New England.....	55	56	56	56½
Tropical (par 10)	....	10¢	....	10¢

	Highest.	Lowest.
Western Union.....	84⅛	82⅝
General Electric.....	75	70¾
American Tel. and Cable.....	85	85
North American.....	9⅛	8⅝
Edison Electric Ill., N. Y.....	105¾	104

The market for Lake Copper was decidedly weaker, the ruling price was 10¾ cents. It is probable that concessions could be obtained on this figure.

New York, June 17.

Addresses at the Electrical Congress of the World's Fair.

TO THE EDITOR OF ELECTRICAL REVIEW:

Will you kindly announce to your readers that the following gentlemen have accepted invitations to read papers at the Electrical Congress:

W. H. Preece, F. R. S., London: "Signaling Through Space by Means of Electro-Magnetic Vibrations."

W. E. Ayrton, F. R. S., London: "Variation of P. D. of the Electric Arc, with Variation of Current, Size of Carbons and Distance Apart."

Dr. Stephan Lindeck, Berlin: "On Materials for Standards of Electrical Resistance and Their Construction."

Professor Mascart is obliged to decline the invitation by reason of other pressing engagements, but he will be present at the Congress.

Both the Army and Navy departments at Washington have detailed officers to attend the Congress.

H. S. CARHART,
Secretary.

Ann Arbor, Mich., June 17.

GENERAL NOTES.

The proposed electric railway line between Appleton and Menasha, Wis, has been surveyed.

The trolley system will shortly be introduced on all the branches of the Camden, Pa., Horse Railroad Company.

The directors of the Western Union Telegraph Company on June 14 declared the regular dividend of one and one-quarter per cent., payable July 15 to stockholders of record June 20.

The Case School of Applied Science, of Cleveland, Ohio, has issued a little brochure descriptive of its new laboratories. Some well selected illustrations show the buildings, class rooms and workshops, all well equipped with the latest improvements.

At the annual meetings of the Erie Telegraph and Telephone Company, and the Southwestern Telegraph and Telephone Company, held in New York, on June 13, the old officers were re-elected. The number of directors was reduced from 21 to 12.

Cutter's "Boulevard" Streethood.

Not satisfied with his bracket and suspension hoods which are now so widely used in all parts of the country, George Cutter has now brought out an ornamental form for use where the regular gooseneck is too plain. The hood proper has the same carefully worked out details as Mr. Cutter's standard forms, including the special nozzles and hinge. The design of the supporting bracket combines strength with beauty, while supporting the lamp at a distance of from three to six feet from the pole or wall. These conducting wires are well insulated from the bracket arm and always in plain sight, so as to avoid all chance of grounds. All told, the Cutter "Boulevard" streethood seems to meet quite a want, so it is not surprising that Mr. Cutter has already supplied large numbers to Western towns.

KINDRED INTERESTS

The Direct U. S. Cable Company has opened an important branch station for the accommodation and convenience of cablers in London, at 50 Old Broad street, Winchester House, directly connected with the cables of the company.

The Interior Conduit and Insulation Company, 44 Broad street, New York, have issued a little souvenir in the form of a pocket screwdriver; a handy little tool, most convenient for offices containing electric fans and other electric lighting apparatus requiring, once in a while, the use of such an instrument.

The Providence and Stonington Steamship Company have sent out the June number of their Bulletin. In it is the continued "History of the Origin and Development of Sound Steamers," descriptive of the past and the present of steam navigation on Long Island Sound, an interesting account of the growth and development of that class of vessel of which their boats rank among the first.

The General Incandescent Arc Light Company, 572 to 578 First avenue, New York, have issued a well illustrated catalogue of their standard, ornamental, chain, bijou, railway and series lamps. Many first-class designs of this now celebrated lamp are shown, affording a chance for a varied selection. A visit to their handsome show rooms and a pleasant description of their various improvements by Mr. S. Bergmann, the president of the company, is an agreeable, instructive and profitable way of spending a little spare time.

The J. H. & D. Lake Company, manufacturers of all kinds of friction clutch pulleys, having outgrown their old quarters at Hornellsville, N. Y., have recently completed and removed to their handsome new offices and foundry at Massillon, O., where, with enlarged facilities, they are prepared to meet the growing demand of their business. An interesting feature regarding the rapid growth of the Lake Company is the fact that it came almost exclusively from advertising, for with the exception of a limited amount of traveling, they have had no representative out on the road, except their card in the various class journals, notably the ELECTRICAL REVIEW.

R. E. Rust, receiver of the National Electric Manufacturing Company, Eau Claire, Wis., says in a recent circular:

"The receiver desires to inform the public that no change whatever will be made in the character of the machinery as heretofore furnished by the National Company, which is believed to be satisfactory in every respect and at least fully as good as any other electrical machinery now in the market. The receiver takes this occasion to say that no change whatever has been made in the office or laboring force heretofore employed by the National Company, and the same high degree of efficiency can therefore be expected in the future as the company has justly earned with the same men in the past.

"All communications should be addressed to R. E. RUST, receiver, Eau Claire, Wis."

Queen & Company, Incorporated, Philadelphia, reported a large stock of "magnetic vane" ammeters and voltmeters, which they can ship promptly and are pushing with great vigor. These instruments combine qualities highly essential for switchboard use, and which render them specially valuable for isolated plants. A number have been supplied to exhibiting companies for installation at the World's Fair, and the makers have a handsome collection in their own display. The "Acme" portable testing set, described in detail last week, has met with favor wherever shown, and is expected to become the standard instrument for general testing. Queen & Company have already received orders for more than 20 sets. Circulars 420 and 445, describing these specialties, can be had for the asking.

Affidavits By Telephone.

[*National Corporation Reporter.*]

Under the heading, "Affidavits by Telephone," we reprinted the query propounded by the *Michigan Law Journal*, "Can an affidavit be legally sworn to over a telephone?" It was said "We do not know that any court has yet been called upon to answer this question."

Our attention has since been called to the subject by Mr. W. H. Layson, First Deputy in the Attorney-General's office of the State of California, who cites the case of Banning *vs.* Banning, decided by the Supreme Court of California, September 2, 1889, 80 Cal. 271. (22 Pac. Rep. p. 210.)

In that case certain deeds were objected to because the grantor, a married woman, was not visibly present before the notary at the time her acknowledgment was taken through a telephone, she then being three miles distant from him. It was admitted in the case that the certificate of the notary was in due form, and it was not alleged or pretended that she did not voluntarily sign and deliver the deeds, nor that she did not voluntarily and without the hearing of her husband, acknowledge the execution of them through the telephone, after having been informed by the notary of their contents; nor that any deception or fraud was practiced to induce her to execute the deeds; nor even that the plaintiffs had notice of the manner in which she acknowledged the execution through the telephone.

The court stated, "These particulars are not stated for the purpose of maintaining that under any circumstances, an acknowledgment may be taken through a telephone, but for the sole purpose of showing that there is no pretense of fraud, duress or mistake." It was finally held that the evidence was not admissible to dispute the official certificate of the notary, which was in due form.

The query is still open, can an affidavit be legally sworn to, or an acknowledgment before a notary be made over the telephone? We apprehend *not*.

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